

The background of the slide is a composite image. The top half shows a modern building with a glass facade, reflecting the sky. The bottom half shows a canal with a small white boat, bordered by lush green plants and a glass wall on the right side.

Engineering for Development (E4D)

Winter School, 3-23 January 2015

GLOBAL WATER CHALLENGES

Welcome

Dear participants,

The winter school is part of the programme "Engineering for Development (E4D) - Science & Technology for the South", funded by the Sawiris Foundation for Social Development. It is organized by ETH Global, the staff unit for international matters at ETH Zurich. The goal of the E4D programme is to promote the development of products or methods which are directly relevant for improving the livelihoods of poor people in developing countries.

The ETH Zurich passes on to its students the highest level of knowledge and skills. It wants everyone to feel at ease and capable in complex and rapidly evolving environments, while at the same time being able to maintain an understanding for ethical and cultural values. The winter school aims at exposing the participants to a selected topic of high relevance in E4D and preparing them to develop context-sensitive solutions.

The three weeks programme will focus on an integrated vision of Global Water Challenges. It will deal with three main topics: Water & Health, Water & Food, and Water & Energy, but it will also explore the links between these topics and the roles of institutions in addressing global water challenges. Participants will learn about the complexities of water policies and they will be challenged to assess technological solutions in a broader societal context. We will create an environment in which you can work in interdisciplinary and international teams together with local and international experts to model solutions in three case studies for China, Bolivia and Zambia.

We look forward to working and learning with you.



Dr. Barbara Becker

Director Global Transformation Affairs, ETH Global



Imprint ETH Global

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January 2015

Acknowledgements

We would like to thank the following people and institutions for initiating, planning, funding and implementing this winter school:

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Introduction

BACKGROUND

The winter school is part of the programme "Engineering for Development (E4D): Science & Technology for the South". The goal of this programme is to promote the development of products or methods which are directly relevant for improving the livelihoods of poor people in developing countries.

The E4D programme has evolved from a scholarship scheme supported by the Sawiris Foundation for Social Development. Since 2008 it has awarded two doctoral scholarships annually. Since 2014 the scope has been expanded to include a series of winter schools, the first of which will take place in January 2015.

STRUCTURE OF THE E4D WINTER SCHOOL

The E4D winter school will be composed of some 24 graduate students from ETH Zurich and from other academic institutions, particularly from developing countries. The Master and PhD students will come from different disciplines related to the E4D topic. They will be joined by faculty members and external experts from fields of expertise related to the winter school topic.

During the first week, students will be introduced to fields relevant to the topic at hand through a series of input speeches, lectures and workshops conducted by experts. All participants will stay in a country house eco hotel in Emmental, 2h away from Zurich. During weeks two and three, students work at ETH Zurich and split into three thematic groups to carry out guided case studies. The case study work will provide them with hands-on opportunities to work in an interdisciplinary and intercultural team and to develop solutions to the chosen topic.

TOPIC OF THE E4D WINTER SCHOOL 2015: GLOBAL WATER CHALLENGES

The E4D winter school 2015 aims at an integrated vision of Global Water Challenges. The programme is designed to present water resources challenges that are of global relevance. Experts will outline the issues and will present their experiences working in different parts of the world. The programme will focus on three main topics: Water & Health, Water & Food, and Water & Energy, but it will also explore the links between these topics and the roles of institutions in addressing global water challenges. Participants will learn about the complexities of water policies and they will be challenged to assess technological solutions in a broader societal context.

Three case studies will cover the main topics and will be based on modelling solutions in a specific country context:

- 1 | Water and Health: Bolivia
- 2 | Water and Food: China
- 3 | Water and Energy: Zambia



Case Studies

WATER AND HEALTH

Water, Sanitation and Hygiene (WASH)

WASH is a UNICEF programme that is central to the millennium development agenda. In 2012, UNICEF expanded its support to WASH in Schools, which aims at providing gender-sensitive and child-friendly sanitation, washing, and water facilities to students. The purpose of this group work is to develop an integrated WASH programme for schools in Bolivia which would combine water treatment with hygiene awareness, handwashing, sanitation, etc. The group work will include field testing of existing household water treatment systems (such as Sodis, gdm-filters, chlorination, and boiling) with different types of water, as well as some lab analysis (microbial analysis).

WATER AND FOOD

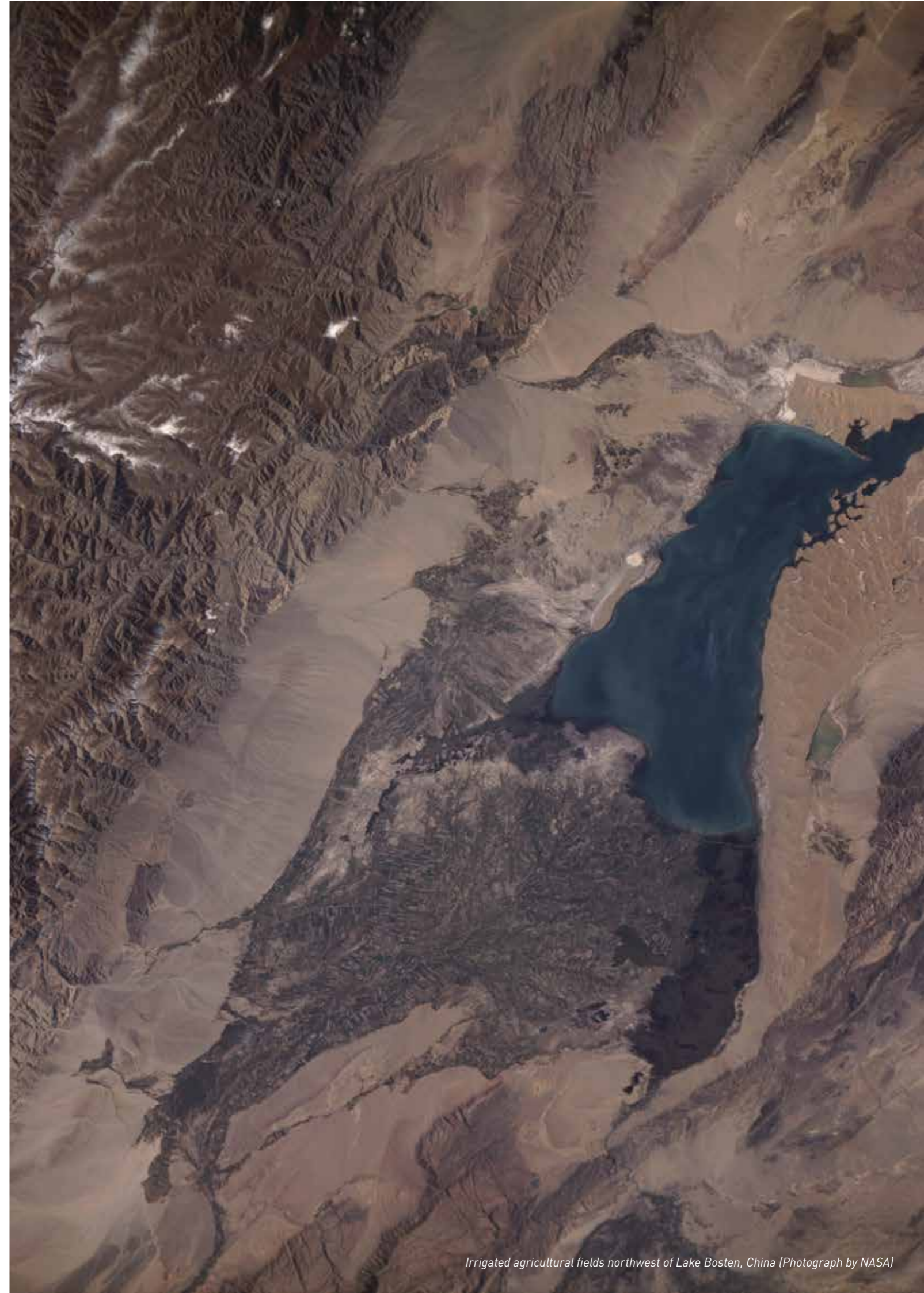
Water allocation for food and ecosystem health

The Yanqi Basin in Northwest China is an irrigation oasis. Agriculture is the main income of the population, but leads to numerous problems: salinization of soils due to groundwater table rise, increasing salinity of Lake Bosten, a fresh water lake receiving all drainage waters from the basin, diminished river flow in the downstream and die-off of *Populus euphratica* forests. You are supposed to formulate sustainability goals and find solutions for the allocation of water with regards to quantity and quality in order to have maximum agricultural production under constraints for soil salinity, downstream ecosystem health, lake salinity and lake water level. A MATLAB software is available which allows you to evaluate each course of action. A Pareto front between economic and ecological benefits should be identified and ideas for implementation should be formulated.

WATER AND ENERGY

Energy-water nexus in the Kafue river basin

In the Kafue Flats, part of the Zambezi River Basin, the operation of two dams built in the seventies has completely altered the hydrological natural regime of this internationally important wetland. Backwater from downstream Kafue Gorges reservoir and releases from upstream Ithezi Thezi dam have created a permanently inundated area within the flats and reduced floods elsewhere, with large impacts on wildlife, vegetation and their dependent livelihoods. The group work will explore the water-energy nexus in the Flats from a multi-stakeholders perspective, by developing, based on the literature available, a set of indicators representing the main interests in the basin, including the ecosystem, the local population and the main economic sectors (sugar cane plantations and hydropower). Using a simplified model of the systems, several alternative operations of the systems (e.g. prioritizing different objectives) will be analysed to explore the tradeoffs among the interests of different stakeholders and explore options for more balanced and sustainable management.



Case Study 1 | Water and Health

Water, Sanitation, and Hygiene (WASH) in Bolivian Schools

Description of Overall Task

You are a team of consultants, hired by an international Green NGO to develop a project outline and approach for improving water, sanitation, solid waste and hygiene (WASSH) of a school in Bolivia.



The NGO expects outcome of this school project to be:

- 1 | Improved drinking water situation (access and quality);
- 2 | Improved sanitation facilities, services and their use;
- 3 | Improved solid waste management at the school;
- 4 | Improved hygiene behavior of students and staff;
- 5 | Improved resource savings and closed-loop recycling (given the NGO environmental image and mandate).

Expected impact is improved school attendance, improved health and hygiene behavior and better environmental education and awareness.

Description of Specific Tasks and Milestones

The NGO requests that the team delivers:

- List of required baseline data. The NGO will provide this as quickly as possible
- Analysis of baseline data, obtained from the NGO and/or other sources.
- Problem Tree, Objective Tree and Logical Framework for the project (i.e. project proposal)

- Hardware (Infrastructure) selection and design and implementation plan
- Software selection and description of implementation procedure
- A budget and long-term financial plan for operation and maintenance of infrastructure

| Date | Task | Milestone |
|----------|--|---|
| 9th Jan | (Morning: presentation of case) Discuss required data Studying existing school WASH guidelines, national WASH in school policies, approaches and cases Studying health situation in Bolivia | <i>Wish list of data: by 17:00</i> |
| 12th Jan | Data analysis and overall situation assessment Input Eawag: Project management; How to develop a logframe | |
| 14th Jan | Problem tree, objective tree and log-frame development Practical exercise: HWTS methods and microbial water quality testing | <i>Project proposal with Logical Framework: by 17:00</i> |
| 15th Jan | Consulting background documents for hardware selection and design Consulting background documents for software selection and implementation | |
| 19th Jan | Practical exercise: Role-play: meeting with stakeholders: consultant, NGO staff, teacher, students, ministry of education | <i>Draft project document to be submitted to NGO by 17:00</i> |
| 20th Jan | Adapt and finalize project document | <i>Final project document to be submitted to NGO by 17:00</i> |
| 21st Jan | Prepare presentation to audience | <i>by 17:00</i> |
| 22nd Jan | Presentation to audience | <i>Presentation ready</i> |

Group Work Program (tentative)

Case study: Bolivian School

- A medium sized elementary school of 150 pupils in rural Bolivia.
- Students between 5 and 11 years of age.
- Limited access to safe drinking water
- Intermittent problems of access to enough water from existing source
- Inadequate sanitation which is seldom used. Mostly open defecation
- No or very irregular solid waste collection
- Irregular energy supply
- School staff salaries paid by government funds
- Some subsidies for books by government, but pupils need to buy books
- Pupils pay some small fee per month/year to attend school
- Kitchen available at school where children get lunch
- Some limited government funds allocated for WASH installations, but none for maintenance & operation.



Enabling Environment

- NGO with money (grant) for investments (max 3 years period of spending)
- Not influenced (neither positively or negatively) by political motives/actions
- Community is motivated and interested in sending children to school and having a good school
- Overall economic condition of households is poor (mostly agriculture activities).
- Local engineers and technicians with WASH experience are available in the closest city
- Closest city (pop 300'000) is 2 hours drive.

Key readings

- < Blue School Concept http://www.sdc-water.ch/en/Home/SDC_s_water_strategies_focus_areas_Water_for_people/Blue_Schools
- < UNICEF WASH in Schools resources http://www.unicef.org/wash/schools/washinschools_53115.html
- < SuSanA: making WASH in schools more sustainable. <http://www.susana.org/en/resources/library/details/2077>
- < SuSanA Forum: sanitation and hygiene in schools <http://forum.susana.org/forum/categories/27-schools-sanitation-and-hygiene-in-schools>
- < Eawag: Compendium of Sanitation Systems and Technologies http://www.eawag.ch/forschung/sandec/publikationen/compendium_e/index_EN
- < Eawag: Anaerobic Digestion of Biowaste in Developing Countries <http://www.eawag.ch/forschung/sandec/publikationen/swm/dl/biowaste.pdf>
- < WSSCC: Hygiene and Sanitation < Software. An overview of approaches <http://www.wsscc.org/node/745>
- < WASH in schools: <http://www.washinschools.info/page/1380>
- < Eawag: Safe Water School Manual <http://www.sodis.ch/safewaterschool/safewaterschoolmanual/safewaterschool-manual.pdf>
- < WHO: Household Water Treatment and Safe Storage http://www.who.int/household_water/en/
- < WHO: Global Health Observatory http://www.who.int/gho/mortality_burden_disease/en/
- < IHME: Global burden of disease <http://www.healthdata.org/gbd>
- < Eawag: MOOC "Introduction to Household Water Treatment and Safe Storage" https://www.youtube.com/channel/UC4_qoddqxeh0JZJXpsuVP9g
- < Eawag: MOOC "Planning & Design of Sanitation Systems and Technologies" <https://www.youtube.com/channel/UCgHWg270mPyst1e5rVFOvCA>

Leader: Christian Zurbrugg
Supervisors: Fabian Suter, Matthias Saladin, (Catherine Ikäe)
Students: Alice Chau, Evangelia Prentouli, Leila Schneider, Capucine Musard, Dwica Wulandari, Maryam Yazdani

Case Study 2 | Water and Food Water allocation for food and ecosystem health in the Yanqi Basin, China

Case study description

The Yanqi Basin in Northwest China is an irrigation oasis. Agriculture is the main income of the population, but leads to numerous problems: salinization of soils due to groundwater table rise, increasing salinity of Lake Bosten, a fresh water lake receiving all drainage waters from the basin, diminished river flow in the downstream and die-off of *Populus euphratica* forests. You are supposed to formulate sustainability goals and find solutions for the allocation of water with regards to quantity and quality in order to have maximum agricultural production under constraints for soil salinity, downstream ecosystem health, lake salinity and lake water level. A MATLAB software is available which allows you to evaluate each course of action. A Pareto front between economic and ecological benefits should be identified and ideas for implementation should be formulated.

Goals

Get an overall understanding of the situation in Yanqi. Identify the stakeholders and their (conflicting) interests. Understand the interaction between the social and the environmental system. Understand environmental risks related to certain agricultural practices as well as risks for society.

Develop an individual approach towards a more sustainable water use and food production through alternative allocation of water, selection of crops and other measures. Understand which are the key factors that could be used to steer the system towards a more desirable state.

Outcomes

– **Report:** The report should present the group's work with respect to tasks 3-5 formulated below. It should focus on the following points:

- Sustainability goals
- Solutions for allocation
- Ideas for implementation

Its length is suggested to be no more than 10 pages.

– **Oral presentation (10-15')**: followed by questions and discussion. The idea of the presentation is to explain the conclusions of the work and to get an insight into the work of the other groups.

Approach: Methodology and tasks

1 | Attend presentation by Prof. Kinzelbach

2 | Read through proposed literature ("priority" list), split up the work among the group members if necessary:

- Brunner (2005) Water and Salt Management in the Yanqi Basin, China (Chapters 1-3)
- Li Haitao (1979) Water Resources Management for Sustainable Development in the Yanqi Basin, Xinjiang, China (Chapters 1-2, 8)
- Li Ning (2012) Zhou Hongfei Irrigated Agriculture And Sustainable Water Management Strategies in the Tarim Basin
- Thevs Niels Water Scarcity and Allocation in the Tarim Basin: Decision Structures and Adaptations on the Local Level (All Chapters)

3 | Formulate sustainability goals

Discuss within the group what you see as targets regarding sustainability with respect to water resources and food security in the basin.

4 | Find solutions for the allocation of water

- a | Use the box-model program at your disposal to evaluate the impacts of selected measures on the salinity, flows, lake level etc.
- b | What allocation strategy should be pursued in your opinion in order to best fulfill the goals?
- c | What are the potential outcomes, impacts and implications of the proposed strategy? What is their nature (Short-term/long-term, local/regional, reversible/irreversible etc.)?
- d | Can you identify a Pareto-front with respect to the indicators considered in the box-model program?

5 | Formulate ideas for implementation

Differentiate between structural/non-structural actions, planning/management actions. Which of these will be easier and which ones may be more challenging to implement?

Leader: Wolfgang Kinzelbach

Supervisor: Gianni Pedrazzini, (Maria Ubierna)

Students: Abebe Guadie, Anna Behmer, Pierpaolo Scaggiari, Rajat Kumar Panda, Ruoji Luo, Mohammad Hatamjafari, Katharina Höreth, Bidur Khadka, Kadir Mohammed



Figure 1: Satellite image of the region (source: Google Earth, 12.12.2014)



Figure 2: Lake Bosten in proximity of the pumping station at the dam (Brunner 2005) of the region (source: Google Earth, 12.12.2014)



Figure 3: Small lake system (Brunner 2005)



Figure 4: Satellite image of the region (Brunner 2005)

Case Study 3 | Water and Energy

Exploring the water-energy nexus in the Kafue river basin, Zambia

Case study description

In the Kafue Flats, part of the Zambezi River Basin, the operation of two dams built in the seventies has completely altered the hydrological natural regime of this internationally important wetland.



Backwater from downstream Kafue Gorges reservoir and releases from upstream Ithezi Thezi dam have created a permanently inundated area within the flats and reduced floods elsewhere, with large impacts on wildlife, vegetation and their dependent livelihoods. The group work will explore the water-energy nexus in the Flats from a multi-stakeholders perspective, by developing, based on the literature available, a set of indicators representing the main interests in the basin, including the ecosystem, the local population and the main economic sectors (sugar cane plantations and hydropower). Using a simplified model of the systems, several alternative operations of the systems (e.g., prioritizing different objectives) will be analyzed to explore the tradeoffs among the different stakeholders and explore options for more balanced and sustainable management.

Objectives

Analyse and model the nexus between energy production (via hydropower generation) and other existing water related, socio-economic interests and environmental aspects affected by the Kafue river flow pattern alterations. Explore the anticipated effects of different operation strategies on this conflict and identify (via simulated negotiation) potential tradeoffs.

Expected outcomes

– Identification and description of the main stakeholders in the river basin, their interests and potential conflicts.

A list of evaluation criteria and quantitative indicators for each group of interest in the basin mapping different hydrologic variables into the stakeholders expectation.

– Analysis of different pre-designed (Ithezi Thezi and Kafue Gorges) dam operating policies corresponding to different trade-offs among the stakeholders using multi-objective visualization tools.

– One or more tradeoffs (i.e., compromise operating policies) potentially gathering large agreement among the stakeholders.



Milestones

- 1 | Report chapter describing stakeholders and interest
- 2 | Report chapter describing criteria and indicators
- 3 | Report chapter describing operation strategies, multiobjective visual analytics, and trade-offs
- 4 | Final report and presentation

Methodology

The Participatory and Integrated Planning procedure developed by Castelletti and Soncini-Sessa (2007) will be used as logical framework to structure and develop the analysis. The procedure will be introduced in the first meeting using as example the transboundary Lake Maggiore case study. The group work will be organized in the following activities:

- 1 | Literature review and virtual system reconnaissance.
- 2 | Identification of decision makers and stakeholders and their potential interest and conflicts.
- 3 | Definition of evaluation criteria for each group of stakeholders and identification/implementation (using Matlab or Excel) of mathematical indicators to quantify these criteria.
- 4 | Evaluation of the indicators for different pre-designed operating strategies (sequences of release from Ithezi-Thezi and Kafue Gorges).
- 5 | Visual analytics of the policy performance as measured by the indicators.
- 6 | Selection, via negotiation, of one or more tradeoffs.

Data and tools

The students will be provided with the following material:

- Papers and reports on the Zambezi River Basin and Kafue Flats.
- Time series of pre-designed operating strategies to be used for the computation of the indicators.
- Time series of main hydrometeorological variables.



Work schedule

Friday 9 – Introduction of the Participatory and Integrated Planning procedure to be used in the case study development. Reading assignment.

Monday 12 – System reconnaissance based on paper and report reading. Tentative identification of the main stakeholders and associated interests. Different work teams representing different stakeholders are created.

Wednesday 14 – Evaluation criteria and associated quantitative indicators are identified and developed (by each work team).

Thursday 15 – Implementation of indicators using excel/matlab (by each work team).

Monday 19 – Computation of the indicators for a set of pre-designed operating strategies and multiobjective visual analytics (by each work team).

Tuesday 20 – Comparative analysis of the policies and negotiation.

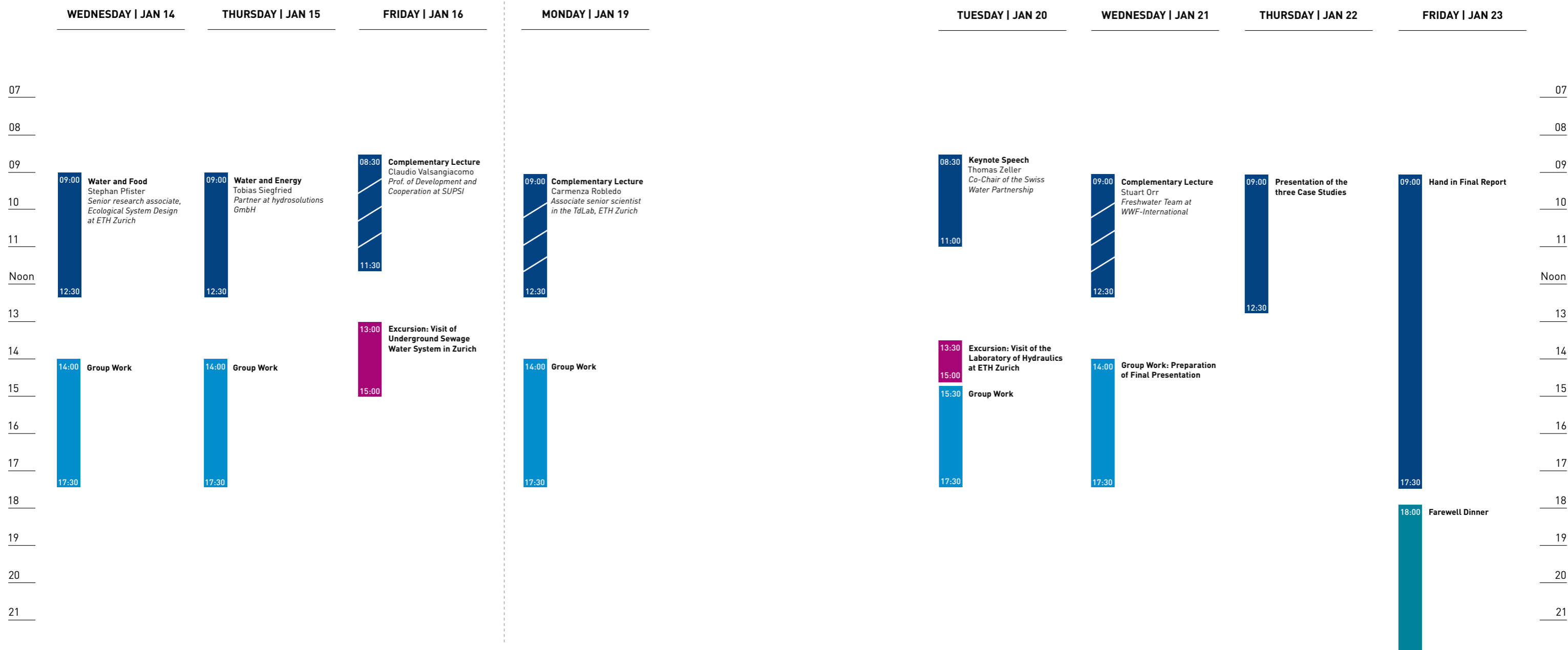
Wednesday 21 – Wrap-up and preparation of the final presentation.

Leaders: Andrea Castelletti, Bernhard Wehrli
Supervisors: Daniela Anghileri, (Maria Ubierna)
Students: Carmen Iten, Allison Jacobson, Demelash Wondimagegnehu Goshime, Fatma Ezzahra Maatar, Leonel Reyes Ochoa, Santosh Neupane, Stephen Siwila, Tiziana Smith

Schedule

| | SUNDAY JAN 4 | MONDAY JAN 5 | TUESDAY JAN 6 | WEDNESDAY JAN 7 | THURSDAY JAN 8 | FRIDAY JAN 9 | MONDAY JAN 12 | TUESDAY JAN 13 |
|------|---|--|---|---|--|---|--|---|
| 07 | | | | | | | | |
| 08 | | | | | | | | |
| 09 | | | | | | | | |
| 10 | 10:00 Brunch at Hotel Möschberg, Emmental | 09:00 Water and Health Session 1 Christian Zurbrügg Head of SANDEC at EAWAG | 09:00 Water and Food Christoph Studer Prof. of Natural Resource Management at HAFL | 09:30 Excursion: Visit of Tropenhaus Frutigen | 09:00 Water and Energy Andrea Castelletti Ass. Prof. of Nat. Resource Mgmt. at Politecnico di Milano | 09:00 Introduction to the three Case Studies | 09:00 Water and Health Isabel Günther Prof. Probl. of Dev. Countries, ETH Zurich/ Director NADEL | 09:30 Excursion: Visit of EAWAG |
| 11 | | Water and Health Session 2 Regula Meierhofer Senior researcher at EAWAG | | 11:00 | | | | 11:00 |
| Noon | | 12:30 | 12:30 | | 12:30 | 12:30 | 12:30 | |
| 13 | | Lunch | Lunch | Lunch | Lunch | Lunch | | |
| 14 | 13:30 Introduction Barbara Becker Wolfgang Kinzelbach | 13:30 Water and Health Session 3 + 4 Christian Zurbrügg Head of SANDEC at EAWAG | 14:00 Water and Food Wolfgang Kinzelbach Prof. emeritus of ETH Zurich | 14:00 Keynote Speech Robert Bos Advisor to the IWA, formerly WHO | 14:00 Water and Energy Bernhard Wehrli Prof. for Aquatic Chemistry, ETH Zurich/ Member of EAWAG Directorate | 14:00 Group Work | 14:00 Group Work | 14:00 Complementary Lecture Mark Smith Director of IUCN Global Water Programme |
| 15 | | | | | | | | |
| 16 | Keynote Speech Wilhelm Meier Special Envoy of Switzerland for Water at SDC | 16:30 | | | | | | |
| 17 | 17:30 | | 17:30 | 17:30 | 17:30 | 17:30 | 17:30 | 17:30 |
| 18 | Dinner | Dinner | Dinner | Dinner | Dinner | Cultural Night | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| 21 | | | | | | | | |

Schedule



Lectures Week 1

Introduction

Barbara Becker, Wolfgang Kinzelbach

SUNDAY | Jan 4th 13:30 – 15:30 pm



Barbara Becker is the Director for Global Transformation Affairs and as such member of the Management Team of ETH Global. Read more >> Organization Team.



Wolfgang Kinzelbach is a professor emeritus of ETH Zurich. He holds a doctorate in civil engineering from the University of Karlsruhe in Germany and a master's degree in physics from the University of Munich

in Germany. His research focused on flow and transport processes in the environment with practical applications in water resources management, pollution control, remediation and nuclear waste isolation. His current main interest is sustainable water resources management in arid and semi-arid regions, chiefly in Africa and China. His latest project is devoted to the monitoring, modelling and control of overpumped aquifers in China. Previously, he held professorships at the University of Heidelberg and the University of Kassel. He is a recipient of the Koerber European Science Award, the Henry Darcy medal of the European Geophysical Union, the Saudi-Arabian Prince Sultan International Prize for Water and the Muelheim Water Award.

Keynote Speech Wilhelm Meier

SUNDAY | Jan 4th 16:00 – 17:30 pm



Wilhelm Meier has developed a long diplomatic career in developing countries. He is currently the special envoy of Switzerland for water and an external member of the Global Advisory

Board at ETH Zurich. After his graduation in Physics at the ETH Zurich, he started a diplomatic career in the Swiss Ministry of Foreign Affairs. In 1998 he became chairman of the committee on Budget, Finance and Administration of the World Trade Organization in Geneva. Afterwards, he was ambassador of Switzerland in several countries such as Uzbekistan, Kyrgyzstan, Tajikistan, Serbia, Montenegro and Brazil.

As special envoy of Switzerland for water he participates in meetings to discuss the issues of regional cooperation in water area, as well as the perspectives for its further development in developing countries.

Water and health | Session 1

Christian Zurbrugg

MONDAY | Jan 5th 9:00 – 10:00 am

The global Issues of Water Sanitation and Hygiene (WASH) and its Health Implications

This session will outline the overall global situation in water supply, sanitation and hygiene (WASH) and discuss the challenges in provision of sustainable and equitable services. We shall discuss the questions: Where do we stand at the end of the MDGs and what has been achieved in the last 15 years? How does the situation in rural areas compare to the urban sector? What are the implications on the public health burden and what are the costs of not having safe water or appropriate sanitation? What have we learned from past failures and what do we recommend to enhance chances of success when introducing improvements? In the debate around sustainability of services, next to the traditional pillars of economic, social and environmental sustainability, we introduce the concept of appropriate technology, institutional setup, and finally knowledge and skills as key features. The session will take a look at key global actors in the WASH sector worldwide and their respective strategies and approaches. Furthermore we will introduce selected knowledge platforms where further information can be obtained.

Further Reading

< UNICEF/WHO, 2014. PROGRESS ON SANITATION AND DRINKING-WATER, 2014 UPDATE.

< UNICEF/WHO, 2009. DIARRHOEA: WHY CHILDREN ARE STILL DYING AND WHAT CAN BE DONE.

< UN-WATER, 2014. UN-WATER GLOBAL ANALYSIS AND ASSESSMENT OF SANITATION AND DRINKING-WATER (GLAAS) 2014 - REPORT.

< WEDC, DFID, 1998. DFID GUIDANCE MANUAL ON WATER SUPPLY AND SANITATION PROGRAMMES - GUIDELINES ON WATER AND SANITATION PROGRAMMES AND LIVELIHOODS, UK DEPARTMENT FOR INTERNATIONAL DEVELOPMENT.

< SSWM 2014. SUSTAINABLE SANITATION AND WATER MANAGEMENT TOOLBOX. [HTTP://WWW.SSWM.INFO/HOME](http://www.sswm.info/home)



Christian Zurbrugg is a senior researcher on water, sanitation and solid waste for developing countries and also heads the Department of Water and Sanitation in Developing Countries (Sandec) at Eawag

(Swiss Federal Institute of Aquatic Science and Technology). His research interests focus on the urban environment in cities of the developing world, in particular on the challenges with regard to solid waste management, environmental sanitation and water supply. In addition to the technical issues of this domain his interests have comprised the economic, institutional and social issues surrounding sustainable solutions for improving health and wellbeing of the urban population by improved environmental services and infrastructure. His research experience is based on projects in a multitude of low and middle income countries in Asian, African and Latin American regions.



Regula Meierhofer is a senior researcher on water supply, water treatment and hygiene behavior at the Department of Water and Sanitation in Developing Countries (Sandec) at Eawag (Swiss Federal Institute of Aquatic Science

and Technology). She has previously led the SODIS reference center at Eawag with the focus on household water treatment options and hygiene behavior which comprised fund raising for water projects, advocacy, as well as design and implementation of water projects worldwide. Her current focus lies on project evaluation and sustainable strategies for the promotion of water services in developing countries. In this regard she works closely with various NGOs and implementation agencies to foster more effective projects and uptake of water treatment technology and behavior change of project beneficiaries. Her research experience is based on projects in a multitude of low and middle income countries in Asian, African and Latin American regions.

Lectures Week 1

Water and health | Session 2

Regula Meierhofer

MONDAY | Jan 5th 10:30 am – 12:30 pm

Session 2: Water Supply and Treatment Systems

This session will outline the issues around water supply and treatment. Access to safe water is taken for granted in most developed countries, but is a severe problem in many developing countries. Besides an often lacking continuity in access - sometimes water is only provided for a few hours every day or a few days a week – water quality is also a critical issue. The main challenge and health risk is water with microbial contamination. The session will elaborate on issue of water sourcing, water lifting and storage as well as water treatment. With regard to water purification a special focus is set on systems that treat water at household level – close to the point of use. Pros and cons of various systems will be discussed. Finally, the importance of approaches and strategies when implementing water projects shall be explained and debated. Presentations of case studies will complement the theoretical background.

Further Reading

< UNICEF/WHO. DRINKING WATER: EQUITY, SAFETY AND SUSTAINABILITY. JMP 2011 THEMATIC REPORT

< THOMAS CLASEN. SCALING UP HOUSEHOLD WATER TREATMENT AMONG LOW-INCOME POPULATIONS. 2009

< RURAL WATER SUPPLY NETWORK. [HTTP://WWW.RURAL-WATER-SUPPLY.NET/EN/](http://www.rural-water-supply.net/en/)

< SKAT. SERIES OF MANUALS ON DRINKING WATER SUPPLIES [HTTP://WWW.SKAT.CH/PUBLICATIONS/PRARTICLE.2005-09-29.5069774463/PRARTICLE.2006-11-02.8410562785](http://www.skat.ch/publications/prarticle.2005-09-29.5069774463/prarticle.2006-11-02.8410562785)

Water and health | Session 3

Christian Zurbrügg

MONDAY | Jan 5th 13:30 – 14:45 pm

Session 3: Sanitation system and technologies

This Session shall focus on the issues of sanitation in low and middle income countries. Sanitation is one of the most off-track MDGs and progress in urban sanitation is proving especially difficult to achieve. The traditional approach of using master plans and engineering decisions has widely failed to meet the needs of low-income communities living in slums, who cannot afford to pay the expected charges for service improvements. This session will elaborate on how to plan for affordable and context-specific sanitation solutions using some state-of-the-art sector planning tools and frameworks such as Community-led Total Sanitation (CLTS), Sanitation 21, Community-Led Urban Environmental Sanitation (CLUES) and the Sanitation Systems Approach. Different sanitation solutions will be discussed whereby a special focus will be set on the full sanitation chain, which includes consideration of the fate of excreta and wastewater beyond the toilet. Exercises and examples shall underline the theory and help participants learn how to select appropriate sanitation systems and technologies for a variety of contexts.

Further Reading

< WA, EAWAG, GIZ, 2014. SANITATION 21 - A PLANNING FRAMEWORK FOR IMPROVING CITY-WIDE SANITATION SERVICES

< EAWAG. 2011. COMMUNITY-LED URBAN ENVIRONMENTAL SANITATION PLANNING (CLUES)

< EAWAG 2014. COMPENDIUM OF SANITATION SYSTEMS AND TECHNOLOGIES

Water and health | Session 4

Christian Zurbrügg

MONDAY | Jan 5th 15:15 – 16:30 pm

Session 4: The opportunities of waste recovery & use

This session will focus on the opportunities of closed-cycle approaches in water and sanitation services. Human waste has a value in terms of its water, nutrient, organic matter and energy content. We will discuss what technical solutions have been developed and what works in low and middle income countries so that recycling of human waste can be enhanced. Specific focus will be on solid waste, excreta and wastewater, exploring the potential benefits and highlighting the risks. The WHO guidelines for the safe use of wastewater, excreta and greywater will be discussed, which follow a concept of multiple barriers and risk assessment. Case study examples will serve to elaborate on practical issues which foster or hinder the sustainability of such actions.

Further Reading

< WHO 2006. GUIDELINES FOR THE SAFE USE OF WASTEWATER, EXCRETA AND GREYWATER. VOLUME 1-4

< EAWAG 2006. GREYWATER MANAGEMENT IN LOW AND MIDDLE-INCOME COUNTRIES

< EAWAG 2014. ANAEROBIC DIGESTION OF BIOWASTE IN DEVELOPING COUNTRIES

< EAWAG 2014. FAECAL SLUDGE MANAGEMENT

Lectures Week 1

Water and Food Christoph Studer

TUESDAY | Jan 6th 9:00 am – 12:30 pm

Water for/in agriculture – challenges and opportunities

Water is a finite resource, very unequally distributed over the globe, and under increasing pressure due to growing demand for various uses. Of all water resources developed, 70% are used (and over 90% consumed) in agriculture since crop and livestock production require immense water quantities. Saving only a few percent of water in agricultural production could thus free up huge amounts of water for other uses. On the other hand, agriculture will have to produce more (and more water-intensive) food as well as other products (such as bioenergy) in the future while water demand in other sectors will rise. The challenge is thus to produce more with less water, i.e. we will have to use water more efficiently in agriculture and produce “more crop per drop”.

Are there opportunities to save water in agriculture and use this resource more efficiently? Fortunately, numerous technical options exist that allow rendering water use in agricultural production more efficient and productive. Obviously, many of these techniques and approaches relate to irrigation and will be explained in the course. In addition to measures that can be applied in irrigated agriculture, various other approaches to achieve gains in water productivity will be discussed at the example of different cases. These include agronomic management practices as well as options relating to international trade.

But why are these opportunities not realized, i.e. why are the known options not yet applied and implemented? Prerequisites for successful application of water-saving techniques and approaches will be highlighted and discussed with the course participants.



Christoph Studer is Professor of Natural Resources Management in the group of International Agriculture at the Bern University of Applied Sciences | School of Agricultural, Forest and Food Sciences HAFL (Zollikofen). Besides his activities in teaching (agricultural production systems in arid and semi-arid areas; management of natural resources, particularly water and soil; sustainable agricultural production), he is engaged in various research and development projects. Furthermore, Christoph is regularly providing international consultancy services (mainly planning and evaluating projects), particularly in the domain of water for agriculture. Before joining HAFL, Christoph has worked at international research centers in Niger (International Crops Research Institute for the Semi-Arid Tropics, ICRISAT) and Syria (International Center for Agricultural Research in the Dry Areas, ICARDA).

Water and Food Wolfgang Kinzelbach

TUESDAY | Jan 6th 14:00 – 17:30 pm

The world water problem

The scarcity of water resources is counted among the top problems for the future of humankind. While in 2000 about 300 million people suffered from water scarcity the number will increase to 4 billion by 2050. Contrary to the picture often drawn in the press this scarcity has nothing to do with our daily drinking water demand but rather with the three orders of magnitude larger amount of water required to produce our food. 70% of all freshwater withdrawn from rivers, lakes and aquifers by humankind is used for irrigated agriculture, which produces 40% of global food. In addition we rely on the rainwater stored in the soil, which supports dry land agriculture. The future development of scarcity is characterized by a growing number of people, an increase in standard of living and diet and therefore a higher demand per capita, and the water demand for agrofuels. In addition supply will decrease in some regions due to climate change on the one hand and non-sustainability of present water supply on the other.

Humankind appropriates more and more water originally supporting the natural ecosystems. Wetland area for example is less than half today of what it was in 1900. The dilemma is that apart from food and energy we also need functioning ecosystems to survive. In the solution of the resulting allocation problem no silver bullet exists and many different methods will be necessary mainly in agriculture, from better plant species to increase yield, via water saving in agriculture and reduction of food waste, to changes in diet to mention just a few.

Problems and solutions will be discussed in detail in this module of the winter school.

The group work will focus on the allocation of water in an agricultural catchment in Western China.



Wolfgang Kinzelbach is a professor emeritus of ETH Zurich. He holds a doctorate in civil engineering from the University of Karlsruhe in Germany and a master's degree in physics from the University of Munich in Germany. His research focused on flow and transport processes in the environment with practical applications in water resources management, pollution control, remediation and nuclear waste isolation. His current main interest is sustainable water resources management in arid and semi-arid regions, chiefly in Africa and China. His latest project is devoted to the monitoring, modelling and control of overpumped aquifers in China. Previously, he held professorships at the University of Heidelberg and the University of Kassel. He is a recipient of the Koerber European Science Award, the Henry Darcy medal of the European Geophysical Union, the Saudi-Arabian Prince Sultan International Prize for Water and the Muelheim Water Award.

Lectures Week 1

Keynote Speech **Robert Bos** WEDNESDAY | Jan 7th 14:00 – 17:30 pm

“You can manage only what you measure”

This popular quote goes to the root of why we invest considerable resources in monitoring. This presentation will look back at the history of monitoring the coverage by drinking water and sanitation services, as a basic need in the 1980s, and as an MDG target over the period 2000-2015. What are the characteristics, myths, strengths and weaknesses of the current global monitoring system? How did the MDG target (Halve, by 2015, the proportion of people without sustainable access to safe drinking water – and to sanitation, an afterthought that came out of the Johannesburg Summit on Sustainable Development in 2002) emerge from the Millennium Declaration? How did the target and its associated indicators get defined? The presentation will go through the milestones in the evolution of global WASH monitoring, in particular the way the WHO/UNICEF Joint Monitoring Programme (JMP) tackled new challenges as they arose. Over time, the landscape of outcome monitoring of access to drinking water and sanitation has become more crowded, while at the country level the need for harmonization of monitoring procedures and the reconciliation of different datasets has become an issue of increasing urgency. And where did the Global Analysis and Assessment of Sanitation (GLAAS) and Drinking Water come from? What are the fundamental differences between GLAAS and JMP in terms monitoring methods and procedures? What is the interface with Sanitation and Water for All (SWA), and the biennial High-level Meetings SWA has been organizing at the World Bank Spring meetings of ministers of finance?



Robert Bos is a Dutch public health biologist who started working for the WHO in 1981. After two-and-a-half years in Costa Rica, he transferred to WHO headquarters Geneva in 1983, and joined the Secretariat of the Joint

WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control (PEEM). This Panel focused on predicting and managing the water-related vector-borne disease impacts of irrigation development and dam construction. In the 1990s he shifted focus to the area of health impact assessment (HIA), in particular of water resources development, and promoted the development, testing and implementation of capacity development (problem-based learning, policy formulation, institutional arrangements) for HIA. In the 2000s he was involved in the negotiations for the POPs Convention, initiatives related to biodiversity, wetlands and human health, and the safe use of wastewater in agriculture. Between 2009 and 2013 he was the Coordinator of the WHO programme on Water, Sanitation and Health. After retiring from WHO in February 2013 he became a senior advisor to the International Water Association in The Hague.

Further Reading

< WATER FOR FOOD, WATER FOR LIFE: A COMPREHENSIVE ASSESSMENT OF WATER MANAGEMENT IN AGRICULTURE. LONDON: EARTHSCAN, AND COLOMBO: INTERNATIONAL WATER MANAGEMENT INSTITUTE.

<SUMMARY AVAILABLE AT: [HTTP://WWW.IWMI.CGIAR.ORG/ASSESSMENT/FILES_NEW/SYNTHESIS/SUMMARY_SYNTHESISBOOK.PDF](http://www.iwmi.cgiar.org/assessment/files_new/synthesis/summary_synthesisbook.pdf)

< FULL BOOK/ALL CHAPTERS AVAILABLE AT: [HTTP://WWW.IWMI.CGIAR.ORG/ASSESSMENT/PUBLICATIONS/BOOKS.HTM](http://www.iwmi.cgiar.org/assessment/publications/books.htm)]

Water and Energy **Andrea Castelletti** THURSDAY | Jan 8th 9:00 am – 12:30 pm

Dammed or damned: the role of large-scale hydropower in the water and energy nexus

There is a close connection, or nexus, between energy and water: it takes water to generate energy, and it takes energy to produce and move water. Water is required to generate hydropower, to cool electric power plants, to extract gas, to produce and transport fuel. Dually, energy is used to convey, clean, and distribute water and treat wastewater. Energy is also consumed when water is used by households and industry, especially through heating and cooling. Changes in global climate patterns and population growth threaten the balance of water available for energy production and other essential and often competing uses, such as agriculture, freshwater supply and ecosystem services. At the same time, water shortages and drought can result in more energy being used to pump water from faraway sources or from deeper wells.

Large-scale water storage systems play a central role in this nexus. Hydropower is the world leading renewable energy and is used in some 150 countries with an installed capacity of approximately 900 GW. Large dams also provide buffers against increasing hydroclimatic variability and water demand. For more than one century, water capacity expansion through dam development has been considered a strategic response to establish water security and foster economic growth, the negative impacts on other uses and ecosystem services being largely underestimated. Nowadays, as water supply expansion is constrained worldwide and water availability is very close to its peak, there is a strong need to shift to a new paradigm where the overall productivity of water is improved by making water management more informed, efficient and sustainable rather than seeking new sources of supply.



Andrea Castelletti is an associate professor of Natural Resources Management at Politecnico di Milano, Italy, and a senior scientist at ETH Zurich. His research interest focuses on modeling and management

of complex hydro-environmental systems, characterized by non-linear dynamics, multiple temporal and spatial scales, multiple operational objectives and multiple stakeholders and decision-makers. He studied and developed new approaches to participatory and integrated water resources planning and management, which have been used in a number of projects in Europe and Vietnam.

Further reading

< GLEICK, P., 2003. GLOBAL FRESHWATER RESOURCES: SOFT-PATH SOLUTIONS FOR THE 21ST CENTURY. SCIENCE 302, 1524-1528.

< GLEICK, P., PALANIAPPAN, M., 2010. PEAK WATER LIMITS TO FRESHWATER WITHDRAWAL AND USE, PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, 107, 25.

< OLSSON, G., 2012. WATER AND ENERGY THREATS AND OPPORTUNITIES, IWA PUBLISHING

< WATER IN THE WEST, 2013 WATER AND ENERGY NEXUS: A LITERATURE REVIEW, STANFORD UNIVERSITY [HTTP://WATERINTHEWEST.STANFORD.EDU/RESOURCES/PUBLICATIONS-DIRECTORY/WATER-ENERGY-LITERATURE-REVIEW](http://waterinthewest.stanford.edu/resources/publications-directory/water-energy-literature-review)

< ANSAR A., B.FLYVBJERG, A. BUDZIER, AND D. LUNN, SHOULD WE BUILD MORE LARGE DAMS? THE ACTUAL COSTS OF HYDROPOWER MEGAPROJECT DEVELOPMENT, 2014. ENERGY POLICY, VOLUME 69, 43-56.

Lectures Week 1

Water and Energy Bernhard Wehrli THURSDAY | Jan 8th 14:00 – 17:30 pm

Towards more sustainable hydropower

The lecture and discussion will center on three topics:

- 1 | Essential criteria for evaluating hydropower dams and development - the World Commission on Dams recommendations.
- 2 | The Swiss "Greenhydro" assessment.
- 3 | Important insights from the ADAPT project in the Zambezi River System.

Further reading

< BRATRICH C., TRUFFER B., ET AL. GREEN HYDROPOWER: A NEW ASSESSMENT PROCEDURE FOR RIVER MANAGEMENT. RIVER RESEARCH AND APPLICATIONS. 20: 865–882 (2004).

< INTERNATIONAL RIVERS. THE WORLD COMMISSION ON DAMS FRAMEWORK - A BRIEF INTRODUCTION. 2008. [HTTP://BIT.LY/1QZNXMR](http://bit.ly/1QZNXMR)

< KUNZ, J., SENN, D. ET AL. OPTIMIZING TURBINE WITHDRAWAL FROM A TROPICAL RESERVOIR FOR IMPROVED WATER QUALITY IN DOWNSTREAM WETLANDS. WATER RESOURCES RESEARCH, VOL. 49, 5570–5584, 2013



Bernhard Wehrli is professor for Aquatic Chemistry at the Department of Environmental Sciences at ETH Zurich. He is also a member of the directorate of the Swiss Federal Institute of Aquatic Science and Technology Eawag. The research of his group is focused on the assessment of biogeochemical processes in rivers and lakes. The group combines chemical sensors, stable isotope techniques and molecular ecology to quantify carbon and nutrient cycles in aquatic systems. Part of his research is focused on the development of interdisciplinary approaches to improve the sustainable management of water resources. Bernhard Wehrli studied chemistry at ETH Zurich and sanitary engineering and water protection in a graduate course. After receiving his Ph.D. with a project in aquatic geochemistry, he spent one year working as a postdoc on weathering processes at Caltech in Pasadena. He was appointed assistant professor for Aquatic Chemistry at ETH Zurich in 1991 and he got tenure in 1997. He worked as a guest scientist in Paris, Jerusalem and Toulouse, France, and conducted field projects in Europe, Asia and Africa.

Together with colleagues from ETH Zurich and Eawag, he initiated an interdisciplinary project on adapting large dams in the Zambezi River Basin to human needs and ecological requirements.

Lectures Week 2

Water and Health

Isabel Günther

MONDAY | Jan 12th 9:00 am – 12:30 pm

Economics of drinking water



Isabel Günther has been Professor for the Problems of Developing Countries and director of NADEL (Centre for Development and Cooperation at ETH Zurich) since July 2014. From October 2008 to June 2014 she was acting as Assistant Professor for Development Economics at NADEL. She had previously been research associate at the Faculty of Development Economics of the University of Göttingen for three years and at the Harvard School of Public Health for one year. Her main research interest is in empirical microeconomics with a particular focus on measurement of poverty, health and population economics, economics of water and sanitation and effectiveness of development aid. Isabel Günther has carried out most of her research in Mali, Benin, Burkina Faso, Ethiopia, South Africa and Kenya.

Further reading | Mark Smith

< KARIN M. KRCHNAK, D. MARK SMITH, ANDREW DEUTZ. PUTTING NATURE IN THE NEXUS: INVESTING IN NATURAL INFRASTRUCTURE TO ADVANCE WATER-ENERGY-FOOD SECURITY. IUCN. 2011. [HTTP://CMSDATA.IUCN.ORG/DOWNLOADS/NEXUS_REPORT.PDF](http://cmsdata.iucn.org/downloads/nexus_report.pdf)

< IUCN. ACHIEVING IMPLEMENTATION OF INTEGRATED WATER RESOURCE MANAGEMENT. WATER BRIEFING. IUCN. [HTTP://CMSDATA.IUCN.ORG/DOWNLOADS/IWRM_WATER_BRIEFING_2.PDF](http://cmsdata.iucn.org/downloads/iwrm_water_briefing_2.pdf).

< IUCN. THE POST 2015 WATER THEMATIC CONSULTATION - WATER RESOURCES MANAGEMENT STREAM. FRAMING PAPER. "WATER FOR NATURE, NATURE FOR WATER". [HTTP://CMSDATA.IUCN.ORG/DOWNLOADS/WATER_FOR_NATURE_NATURE_FOR_WATER_FRAMING_PAPER.PDF](http://cmsdata.iucn.org/downloads/water_for_nature_nature_for_water_framing_paper.pdf)

Complementary Lecture

Mark Smith

TUESDAY | Jan 13th 14:00 – 17:30 pm

Nature as water infrastructure



Mark Smith is the Director of the International Union for Conservation of Nature (IUCN) Global Water Programme. He leads IUCN's work on water, environment and development at the global level and provides strategic leadership for IUCN on water policy and development. He coordinates the Water Programme's portfolio of water projects including BRIDGE – 'Building River Dialogue and Governance', the Nexus Dialogue on Water Infrastructure Solutions, and WISE-UP 'Water Infrastructure Solutions from Ecosystem Services Underpinning Climate Resilient Policies and Programmes'. He led IUCN's Water and Nature Initiative (WANI) from 2009-2012. Dr Smith steers the work and knowledge on Water and Climate Change, Food Security, Governance, and Resilience at IUCN Headquarters as well as through collaboration with IUCN offices in Latin America, Africa, the Middle East, Asia and Oceania. Dr Smith is currently a Governor at the World Water Council. He has authored numerous publications on water resource management and the environment.

Lectures Week 2

Water and Food Stephan Pfister WEDNESDAY | Jan 14th 9:00 am – 12:30 pm

Water consumption in food production and related life cycle impacts (Water Footprint)

This session will address environmental aspects of the water–food nexus, which is one of the major issues globally. Unlike other environmental problems such as global warming or land use, the impact of water consumption in food production is concentrated in water scarce regions, often featuring intensive irrigation. Since water problems are often hidden in the supply chain of highly globalized markets, this means that the consumer of food products might be completely unaware of water use related problem. Consumers are only “tele-connected” with producer regions and awareness is therefore rather low.

The human influence on the hydrological cycle is highly dominated by agriculture and the presentation will highlight the distribution of this impact over the world and connect it to traded goods and final consumption. It will highlight the relevance of different steps in food production; including processing and food waste and outline upcoming challenges of an increasing population with higher demand of food in terms of quantity and quality.

Different methods to assess the environmental impact of the food sectors on the water resource will be presented and compared to land use impacts, since they are often at a trade-off: Principally agricultural expansion is occurring on highly productive areas such as rainforests, where little or no irrigation is required or on marginal lands, which require irrigation and fertilizer input. A similar trade-off has a farmer on a field in a water limit climate, as he might reduce land use per produced unit of food by intensifying irrigation, which on the other hand leads to increased water impacts. These aspects are used to identify mitigation options.

The goal of this session is to (1) understand the relevance of water consumption in agriculture and its consequences on life cycle assessment in food

production (2) get to know concepts to analyze water impacts on the environment from a global perspective (water footprinting) and (3) understand the knowledge gaps and resulting uncertainties in such assessments.



Stephan Pfister is a senior research associate at ETH Zurich in the group of Ecological Systems Design. His methodological focus is on the impact assessment of water consumption and land use in Life Cycle Assessment (LCA) with applications to agriculture and power production. In this context, he advanced water footprint concepts, including future assessments and international trade. Other research foci include uncertainty assessments, communication of results to decision makers, effects of heat emissions and proper assessment of GHG as well as phosphorus emissions in agricultural LCA. He is teaching part of the Advanced Environmental, Social and Economic Assessments course at ETH and is member of the «ecoinvent Editorial Board» responsible for water data collection and associated editor for The International Journal of Life Cycle Assessment.

Water and Energy Tobias Siegfried THURSDAY | Jan 15th 9:00 am – 12:30 pm

Central Asia - Water Resources and Management Challenges in the Context of Political and Environmental Change

Millions of people in the geopolitically important region of Central Asia depend on water from snow- and glacier-melt driven international rivers, most of all the Syr Darya and Amu Darya. The lecture will shed light on the history of the irrigation societies in the region, their current challenges with regard to the management of the transboundary waters there as well as provide an outlook over expected 21st century developments and associated problems.

Ever since the Soviet Union collapsed, the riparian countries of the large Central Asian rivers have experienced recurring water allocation conflicts. On top of that, the lack of adequate investments in the maintenance and upgrade of the hydro-meteorological network have led to a critical deterioration of the knowledge about the space-time dynamics of water. Yet, the latter is necessary when viewed from the perspective of the requirements of effective water resources management. Current initiatives for using low-cost, high-tech approaches to increase the coverage and exchange of relevant data for greater transparency and water sustainability are presented and discussed.

In this context, an important question is whether climate change will exacerbate water stress and thus conflicts over the next decades. Coupled climate, land-ice and rainfall-runoff modeling for the Syr Darya for the quantification of impacts show that climatic changes are likely to have consequences on runoff seasonality due to earlier snowmelt. This will increase water stress in unregulated catchments because less water will be available for irrigation in the summer months. Threats from geohazards, above all glacier lake outbursts, are likely to increase as well. The area at highest risk is the densely populated, agriculturally productive, and politically unstable Fergana Valley. As a consequence, targeted infrastructural developments will be required in the region.

If the current mismanagement of water and energy resources can be replaced with more effective resource allocation mechanisms through the strengthening of transboundary institutions, Central Asia will be able to successfully address future climate-related challenges and will be more resilient to societal changes, including those stemming from increasing population pressure and political transformation.



Tobias Siegfried is a senior scientist partner in Hydrosolutions GmbH. Prior to this position he was an associate research scientist at the Columbia Water Centre, The Earth Institute and an Adjunct Assistant

Professor at the School of International and Public Affairs, both at Columbia University. Dr. Siegfried studied environmental physics at the Swiss Federal Institute of Technology ETH Zurich, Switzerland and International Relations at the London School of Economics and Political Science in London, U.K. He received his PhD in non-cooperative transboundary groundwater use from the Institute of Environmental Engineering at ETH Zurich in 2004. While integrating physical, social, economic and policy analysis, he studies numerous natural resources management challenges, from local up to global scales. Dr. Siegfried has completed field studies in Northern, Eastern and Southern Africa and is involved in ongoing work in Central and South Asia. He publishes his interdisciplinary scientific work in leading journals of the respective fields such as the Journal of International Affairs, Journal of Sustainable Development, and Water Resource.

Further reading

< TOBIAS SIEGFRIED, THOMAS BERNAUER. ESTIMATING THE PERFORMANCE OF INTERNATIONAL REGULATORY REGIMES: METHODOLOGY AND EMPIRICAL APPLICATION TO INTERNATIONAL WATER MANAGEMENT IN THE NARYN/SYR DARYA BASIN WATER, VOL. 43, W11406, DOI:10.1029/2006WR005738, 2007

< TOBIAS SIEGFRIED, THOMAS BERNAUER, RENAUD GUIENNET ET AL. WILL CLIMATE CHANGE EXACERBATE WATER STRESS IN CENTRAL ASIA? CLIMATIC CHANGE DOI 10.1007/S10584-011-0253-Z. 2011

Lectures Week 2

Complementary Lecture

Claudio Valsangiacomo

FRIDAY | Jan 16th 9:00 am – 12:30 pm

Drinking water during emergencies

Water is an essential element to survival. Natural disasters and other types of incidents can disrupt drinking water and wastewater systems. If a natural or man-made disaster strikes a community, the access to clean water is often lost, within few hours drinking water can become the first urgently needed item. In such an emergency, having a supply of clean water for drinking, cooking, and hygiene represents therefore a top priority. According to SPHERE, a set of minimum standards in core areas of humanitarian assistance, a human being needs at least 3 lt per day for drinking and 12 lt per day for cooking and hygiene. The presentation will focus on how to provide drinking water during emergency situations by describing crucial actions to be taken while assessing water quality, disinfecting and distributing water to the affected population.

Further reading

< WHO/WEDC TECHNICAL NOTES ON WASH IN EMERGENCIES:
[HTTP://WWW.WHO.INT/WATER_SANITATION_HEALTH/HYGIENE/ENVSAN/TECHNOTES/EN/](http://www.who.int/water_sanitation_health/hygiene/envsan/technotes/en/)



Claudio Valsangiacomo (born 1962) is a biologist with a PhD from the Federal Institute of Technology of Zurich. He is Professor for development and cooperation at SUPSI, leading since 2007 the Office for Development

and Cooperation of the Rectors` Conference of the Swiss Universities of Applied Sciences.

He did research in life sciences and underwent further specialization in clinical and food/water microbiology in public health laboratories (Canton of Ticino). He has been involved in development and humanitarian projects since 2001, with international consultancies in developing countries on behalf of the Swiss Development and Cooperation Agency (SDC), for the World Health Organization (WHO) and for the United States Department of Agriculture. Countries: Albania, Armenia, Azerbaijan, DR of Congo, Guinea Conakry, Haiti, Indonesia, Ingushetia, Malta, North Ossetia, Pakistan, Philippines, Serbia, Slovenia, Tajikistan, Thailand, Zimbabwe.

Lectures Week 3

Complementary Lecture

Carmenza Robledo

MONDAY | Jan 19th 9:00 am – 12:30 pm

Interface between science and development cooperation: paradise or battle field?

In this session we will explore the relationship between the scientific community and the development community: Is it necessary that these communities collaborate? Why? What can science bring to development cooperation and vice-versa? What makes it challenging to work together? What are the advantages and the gains of collaborating? What are the risks?

The topic of climate change brings us a great case study for understanding the challenges and opportunities in the interface between science and development cooperation. Why? Because during the last –at least – 10 years climate change has been very high on both, the research and the development agendas.

We will clarify what the interface between science and development cooperation is and what are the concrete challenges and opportunities that a scientist has to face when conducting research in the framework of development activities. Further we will discuss what are the possible gains of building a joint knowledge basis for development interventions. The theoretical aspects will be clarified using concrete examples from the climate change scene. In the second part of the session we will have an interactive exercise dedicated to the water sector.

Further reading

< STRYDOM, WILMA F ET AL. EVIDENCE-BASED POLICYMAKING: A REVIEW. S. AFR. J. SCI. [ONLINE]. 2010, VOL.106, N.5-6 [CITED 2014-12-11], PP. 17-24 . AVAILABLE FROM [HTTP://WWW.SCIELO.ORG.ZA/SCIELO.PHP?SCRIPT=SCI_ARTTEXT&PID=50038-23532010000300010&LNG=EN&NRM=ISO](http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=50038-23532010000300010&lng=en&nrm=iso). ISSN 0038-2353.

< HEAD, B.W., 2010. RECONSIDERING EVIDENCE-BASED POLICY: KEY ISSUES AND CHALLENGES. POLICY SOC., EVIDENCE-BASED POLICY 29, 77-94. DOI:10.1016/J.POLSOC.2010.03.001



Carmenza Robledo is an associated senior scientist in the TdLab of the Department of Environmental Systems Science at ETH Zurich with almost 20 years of professional experience, combining scientific research and development cooperation.

In her work she combines scientific research, policy advice and project implementation. She has project experience in Latin America, Africa and Asia, as well as advising international organizations. Recently she participated as Lead Author in the last Assessment Report of the IPCC. Carmenza worked as a Senior Scientist in the EMPA. In 2003 she joined HELVETAS Swiss Intercooperation as Climate Change Task Manager where she lead the Environment and Climate Change Team from 2009-12. Since 2012 she combines scientific research at the ETH Zurich with consultancy work. Her competences are climate change and natural resource management in the context of development cooperation.

Lectures Week 3

Keynote Speech **Thomas Zeller** TUESDAY | Jan 20th 8:30 – 11:30 am

Session 1 will focus on the Swiss Water Partnership (SWP): Its objectives, activities, how it found its place in the water sector in Switzerland, and its links to the Swiss Agency for Development and Cooperation (SDC).

Session 2 will focus on the SWP's activities related to the post 2015 Sustainable Development Goals (SDGs) and its involvement in the SDG process, with an outlook until the General Assembly of the United Nations in September 2015.



Thomas Zeller is co-chair of the Swiss Water Partnership. He is a former senior water policy advisor of the Swiss Agency for Development and Cooperation (SDC) and has 20 years of experience in development

cooperation in the water sector in Africa and Latin America, with a strong focus on irrigation and integrated water resources Management.

Thomas Zeller is an agricultural engineer with almost 20 years of field experience in rural development in Africa and Latin America followed by over 10 years experience at the headquarters of SDC in Bern in thematic backstopping of SDC operations around the world in the fields of rural development, agriculture, health and water.

He has worked for a Swiss Non-Governmental Organization, German GTZ and SDC. His vision and strengths are in integrated approaches, including the participation of all stakeholders.

Complementary Lecture **Stuart Orr** WEDNESDAY | Jan 21th 9:00 am – 12:30 pm

Business and water risk – should we be worried?

This session will discuss the evolution and foundations of an increased concern from the private sector and their relationship to water resources. We will look at both the origins of this debate as well as trace the response – the good, bad and ugly. The session will raise new questions on private sector roles and responsibilities with regard to water management as well as identify where business is 'gaming' the system, staking sustainability positions as well as genuinely reconciling their business growth with ever increasing water shortages.

In particular, business engagement in water management debates, and especially public policy, provokes significant concerns from some NGOs and the public, including fears about business takeover of global resources. At the core of these concerns are two issues:

1. Water is a highly complex public resource with multiple socially defined functions and values. Its effective management requires the continual reconciliation of trade-offs between private interests and collective well-being, not to mention fulfilment of a fundamental human right.

2. Although they must "have regard to" wider social and environmental interests, many companies are legally obliged to prioritize a narrow set of shareholder interests (Newborne and Mason, 2012). To ensure that the profit motive of companies is balanced with social and environmental values, those concerned must be able to separate business water response and rhetoric from substantive action, and challenge and measure company participation in ways that benefit more than just the near-term financial bottom line. However, dogmatic stances against business will be counter-productive. Given the world's spiralling water challenges, the underwhelming implementation of integrated water resource management and the lack of government

investment in water, we must explore all potential avenues for change.

Students will be invited to engage in a debate that will challenge perceptions around the future of water management.

Further reading

< PEGRAM, G., ORR, S. AND WILLIAMS, C. (2009) INVESTIGATING SHARED RISK IN WATER: CORPORATE ENGAGEMENT WITH THE PUBLIC POLICY PROCESS, WWF-UK, SURREY, UK.

< MORRISON, J., SCHULTE, P., ORR, S., HEPWORTH, N., PEGRAM, G., CHRISTIAN-SMITH, J. (2010) GUIDE TO RESPONSIBLE BUSINESS ENGAGEMENT WITH WATER POLICY, PACIFIC INSTITUTE/THE CEO WATER MANDATE, UN GLOBAL COMPACT, OAKLAND, CA.

< NEWBORNE, P. AND MASON, N. (2012). THE PRIVATE SECTOR'S CONTRIBUTION TO WATER MANAGEMENT: CLARIFYING COMPANIES' ROLES AND RESPONSIBILITIES. WATER ALTERNATIVES 5(3): 604-619.



Stuart Orr works with the private sector on a range of water related activities, from water accounting measures to public policy engagement. Stuart has published on water measurement, agricultural policy and

water-related risk, and recently co-drafted guidelines for the UN Compact on corporate engagement in water policy. He has an academic and research background in agricultural systems and water resource management and worked for many years in the private sector in Asia and the US. He is a member of the World Economic Forum's Council for Water Security and sits on a number of sustainability panels. He holds an MSc in Environment and Development from the School of International Development at the University of East Anglia and is based in Switzerland at WWF-International.



Excursion Tropenhaus Frutigen

WEDNESDAY | Jan 7th 9:30 am – 12:00 pm



Introduction

Tropenhaus Frutigen is a model company in connecting the sustainable sturgeon breeding and exotic fruit cultivation and the gastronomy in a sensitive manner that can be readily experienced. It takes a leading role in the use of renewable energy in the Alpine region.

The Tropenhaus Frutigen project was started in 2002 with a feasibility study and in 2003 the start-up company was set up with headquarters in Frutigen. Tropenhaus Frutigen is considered a pioneer in the field of sustainable fish breeding in land-based aquacultures. High-performance, professional production facilities for breeding freshwater fish are at the heart of the facility. 18-degree hot, high quality water from the inside of the Lötschberg Mountain forms the ideal environment for the Siberian sturgeon.

It highlights suitable ways for using alternative energies and applies them in practice. The largest proportion of the required energy is taken from the warm mountain water from the base tunnel of the Lötschberg mountain. The remaining energy required will be covered by additional, equally sustainable sources, namely the sun, water and biomass.

9:30 | Aquaculture and Energy tour

The tour will start with a brief introduction to the history of the Tropenhaus. The warm water coming from the Lötschberg Mountain is not suitable for the local ecosystem, thus cannot be released directly to the waterways due to its high temperature. Tropenhaus Frutigen conceived this problem as an opportunity to breed sturgeon and produce tropical fruit, through an innovative approach.

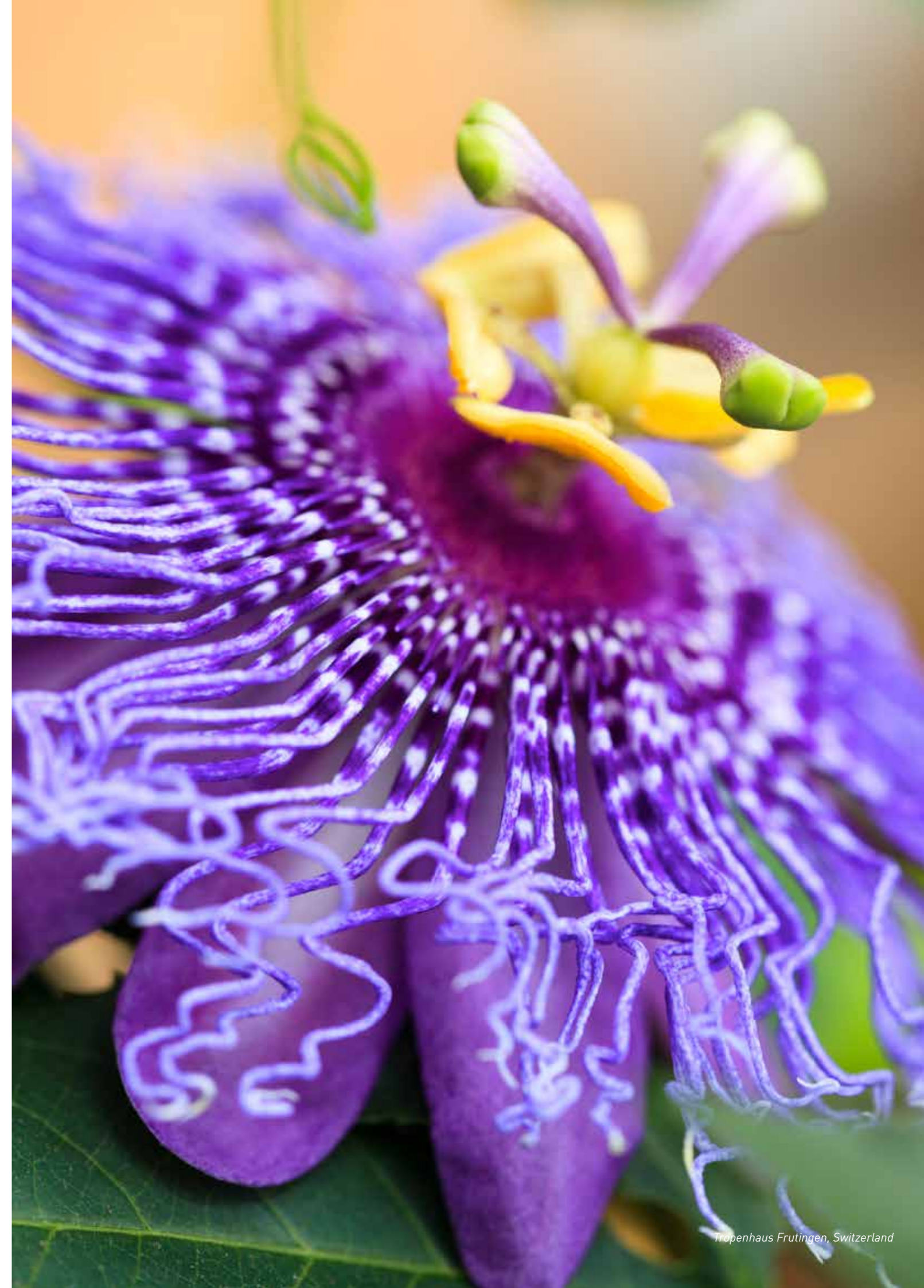
The aquaculture tour will include the cyclical fish breeding system in Frutigen, its equipment, how it works and sturgeon breeding facilities. The energy tour will include the water tunnel, the technology and the energy cycle. The energy cycle consists of the following phases:



- Energy, water and nutrients are fed through the system at Tropenhaus Frutigen. Every area, every building is completely integrated into the cycle
- The warm water from the Lötschberg mountain heats the hot house
- Water is cooled from 18 to 12 degrees in the various fish tanks
- Water from the roof is collected for irrigation in special rainwater containers
- The hot house is heated and the external users supplied with the central local heating network
- A water turbine uses surplus water from Frutigen to generate electricity
- The facility's operation is ensured by its own photovoltaic system on the roof of the Tropenhaus
- Green waste is supplied to the biogas plant for electricity generation. The restaurant uses fish and fruit cultivated in Tropenhaus. Sturgeon meat, caviar and fruit are processed in the manufacturing process for the in-house restaurant and sales.



Finally we will get the chance to walk through the tropical garden and enjoy the nice and warm temperatures during the Swiss winter.



Tropenhaus Frutigen, Switzerland



Excursion EAWAG

TUESDAY | Jan 13th 9:30 am – 12:00 pm

EAWAG

Eawag is the Swiss Federal Institute of Aquatic Science and Technology and is one of the world's leading institutes for aquatic research. It works on concepts and technologies that are aimed at ensuring the sustainable use of the world's water resources and is committed to reconciling ecological, economic and social interests in water as a resource. Eawag also provides teaching and consultancy services, thus forging an important link between research and practical application.

Over 450 people are employed at the sites in Dübendorf near Zurich and Kastanienbaum near Lucerne. Eawag was founded in 1936 as a consulting agency for wastewater treatment.



Forum Chriesbach – Sustainability in Public Buildings

The research activities of Eawag, the Swiss Federal Institute of Aquatic Science and Technology, are governed by the principle of sustainable development, and the institute attaches great importance to operating its buildings in a resource-efficient way. This commitment is nowhere better reflected than at Eawag's own headquarters, the Forum Chriesbach office building, which distinguishes itself in terms of its energy efficiency and pioneering water management system. Opened in 2006, the new building has set standards in the field of sustainable development by doing without conventional heating and cooling systems and consuming very little energy for heating. The building's electricity requirements are met fully from renewable sources, with power being drawn either from the photovoltaic system on the roof or

from eco-certified suppliers. Thanks to the building's lower operating costs, the slightly higher investment required to secure energy efficiency will be offset in the space of a few years.

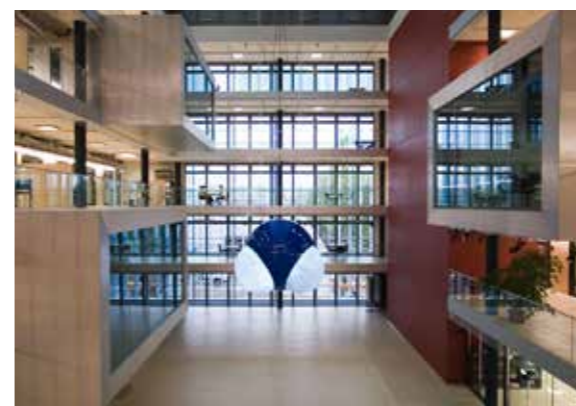
High-level Specifications

A high-level specification and innovative architectural and technical design resulted in the creation of an exemplary research and development centre. Creating a synthesis of functionality, aesthetics and structural quality while insisting on the application of sustainable building criteria required close cooperation between the client Eawag-Empa, the general planner Bob Gysin + Partner BGP and the general contractor Implen Generalunternehmung AG.

In addition to various functional, financial and aesthetic requirements, Eawag and Empa insisted on the implementation of key sustainability criteria for the Forum Chriesbach project. The structural and technical measures were to be innovative, even going beyond the state of the art of the time. Specifically this meant:

- Conserving resources (energy, materials, land, finances)
- Striving to achieve the status of a low-energy building
- Meeting at least one-third of the building's electricity requirements with a photovoltaic system
- Integrating a urine separation system and rainwater recycling
- Achieving a compelling cost-benefit ratio

The building's facade of self-adjusting, blue glass panels is striking. The façade blocks the direct rays of the sun in the summer and allows them into the building in the winter. Together with the sophisticated ventilation system and the highly insulated building shell, this feature makes active heating and cooling virtually superfluous. The photovoltaic system on the roof takes care of a proportion of the building's electricity requirements. The five-storey atrium with its glass roof lets light into the building during the day while helping to cool it down at night in the summer. The rest of the roof is extensively greened. NoMix



toilets, which collect urine separately, are installed throughout the building. Resource-saving materials and a decision to do without a luxurious interior helped to reduce the amount of grey energy invested.

Indoor Climate

Forum Chriesbach has neither a conventional heating system nor active cooling. Only the conference rooms, seminar rooms and auditorium have been outfitted with a water circuit in the ceiling to enable cooling in these rooms when necessary. The ventilation in the work areas is continuous and centrally controlled. Fresh air flows in through geothermal tubes (78 20-metre pipes) to the central ventilation unit and is then distributed via the riser shafts. The exhaust air is discharged through the roof, in summer directly from the offices and in winter via heat exchangers. In the winter the fresh air intake is heated by the geothermal tubes and by the heat recovered from the server room. On very cold days, extra heat can be sourced from the central hot water tank. The atrium serves as a buffer zone and is not actively ventilated. On hot summer days, it serves as a flue for automatic night cooling. As soon as the outside temperature drops below room temperature, the hinged windows in the offices and atrium roof open.

Water

Using rainwater from the roof to flush the toilets saves about 400–500 m³ of costly drinking water each year. Drinking water is used only for the kitchen in the staff canteen, for the water fountains located around the floors and for washbasins. Rainwater is harvested on the green roof, stored in the 80 m³ water garden in front of the staff canteen and fed by separate plumbing to the toilets. Rainfall on paved and surfaced areas is collected in an open channel and fed into a drainage area. Forum Chriesbach has only waterless urinals and NoMix toilets, in which

urine and faeces are collected separately. The urine is collected in tanks and turned into fertiliser in a pilot system. Using NoMix technology allows scientists to gain practical, first-hand experience and to explore new avenues of research

Energy

The heat generated by people, office equipment, lighting and natural sunlight makes a passive contribution to the pleasant ambient temperature. According to a study carried out in 2009, only 6 kWh / m² a of heat and 17 kWh / m² a of electricity had to be actively fed into the building (servers excluded). This makes Forum Chriesbach one of the world's most energy-efficient buildings. The hot water tank (3 m³) and the thermal storage unit (12 m³) are heated by solar collectors, waste heat from refrigeration equipment in the kitchen and, at very low outside temperatures, from the local Empa-Eawag heating network. The vacuum tube collector system has a surface area of 50 m² and provides around 26,000 kWh of heat a year. Part of the building's electricity consumption is supplied by a 459 m² solar installation on the roof, with a capacity of 77 kWp. This system produces around 70,000 kWh of electricity per year.

Programme

9.30 | Presentation of Eawag and Forum Chriesbach – Thomas Lichtensteiger, Daniel Beerle

9.50 | Guided Tour including visit of the urine tanks and presentation of the project by Bastian Etter

11.00 | Presentation of Sandec - Chris Zurbrügg. Sandec is the Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute of Aquatic Science and Technology (Eawag).



Excursion Waste Water Treatment

FRIDAY | Jan 16th 13:00 – 15:00 pm

Wastewater treatment plant Werdhölzli

The wastewater treatment plant (WWTP) Werdhölzli in Zurich is the largest sewage treatment plant in Switzerland. The Disposal + Recycling Department (ERZ) of the city of Zurich operates the plant.

The plant Werdhölzli also cleans the wastewater from six connecting communities: Adliswil, Kilchberg, Opfikon, Rümlang, Wallisellen and Zollikon.

Key figures 2013:

Employees: 87

Waste water purified from: 433,000 persons

Wastewater volume: 80.6 million m³

Influent flow when dry weather: 3,000 liters per second

Influent flow when wet weather: 6,000 liters per second.

The wastewater treatment consists of four steps:

Mechanical treatment

No-soluble contaminants are removed from the wastewater: textiles, papers and wood are caught in the rake, stones are locked in the sand traps and grease and oil are collected on the water surface by aeration.

When the sewage is exempt from these residues, it flows in the primary sediment tanks, where suspended solids settle. These will form the primary sludge.

Biological Treatment

Microorganisms in the activated sludge remove most of the organic dissolved pollutants: they convert ammonium to nitrate and this into nitrogen.

Chemical treatment

This process takes place parallel to biological treatment. The wastewater contains phosphates derived from washing and cleaning products and food.

Therefore iron salts are supplied to the waste water so the phosphates precipitate to form insoluble substance, which can be removed with the activated sludge in the secondary sedimentation tank. This secondary sludge is together with the primary sludge the source for the anaerobic digestion.

Filtration treatment

The remaining suspended solids are filtered in the filter chamber by a sand layer. In this fourth treatment, it is possible to add extra iron salts to remove the phosphate content depending on the water quality.



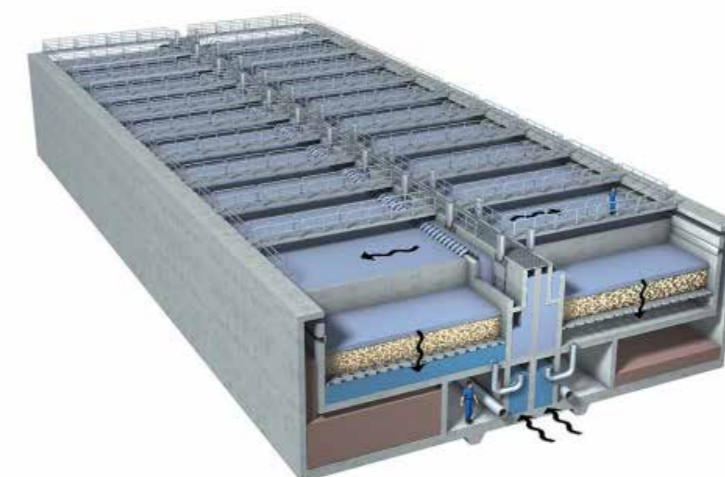
After the opening of the first plant in 1926, the treatment plant was built in several stages. The processes of the current plant expansion run since 1986. The WWTP Werdhölzli consists of four stages: mechanical, biological, chemical and filtration.

No later than three hours after you have activated your toilet flushing, the wastewater arrives at the sewage treatment plant. The plant cleans up to 80 million cubic meters of wastewater a year. After the four-stage cleaning, ERZ leads the clean water into the Limmat and thus the water cycle continues. Once the sludge is stabilized and reduced in volume, it is sent to the thermal power plant Hagenholz. This plant converts the waste from the city of Zurich in heat and electricity. With an efficiency of about 70 percent Hagenholz is the leading Swiss waste thermal power plant. The biogas produced by the digestion of the sludge at the treatment plant covers the entire energy demand of the WWTP Werdhölzli.



Grease and oil removal at the surface through aeration and fine sand trap at the bottom.

Primary tank: suspended soils settle



Filtration: the last purification step.

Information source:

https://www.stadt-zuerich.ch/ted/de/index/entsorgung_recycling/sauberes_wasser/klaerwerk.html

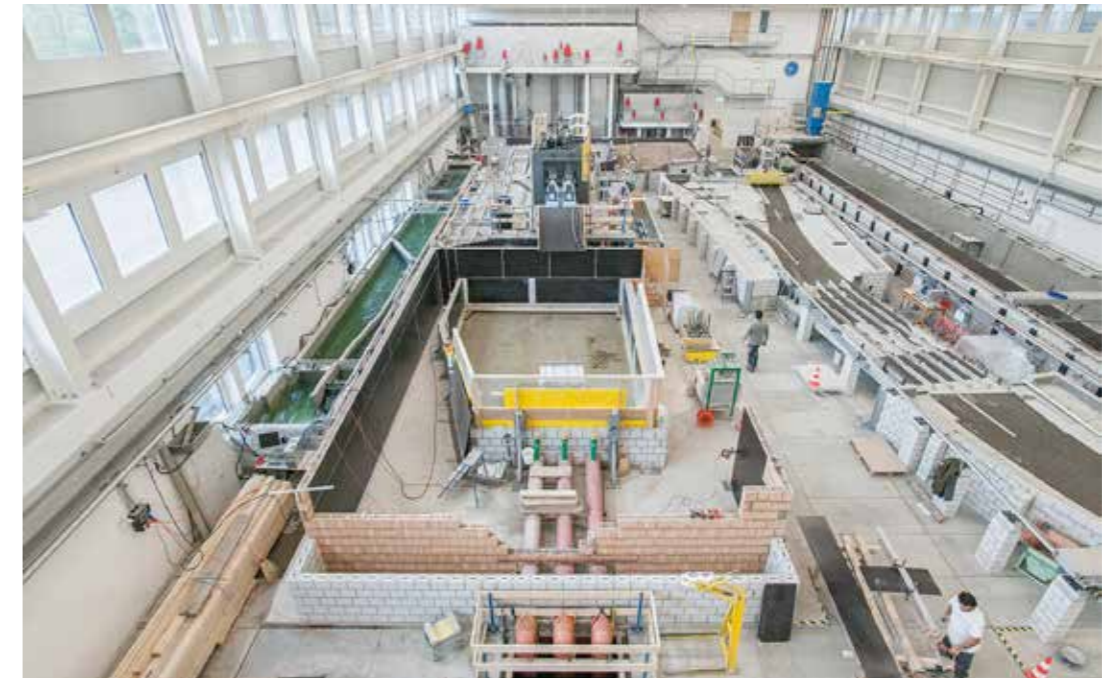
Excursion VAW Lab

TUESDAY | Jan 20th 13:30 – 15:00 pm

Introduction

The Laboratory of Hydraulics, Hydrology and Glaciology (VAW) conducts research and teaching in the fields of hydraulic engineering, river engineering and glaciology. Studies in the areas of hydraulic structures for energy production, irrigation and water supply, protection against natural hazards and revitalization of watercourses are complemented by research and services in the areas of dynamics of polar ice streams and glaciers, as well as processes relating to glaciers and climate change.

Besides research and teaching, services are offered to public administrations as well as to private companies, mainly the Power Industry and Consulting Engineers. These services include expert advice, hydraulic and hybrid model testing as well as numerical simulations of hydraulic structures and systems.



13:30 | VAW Lab tour

Brief introduction of two of the ongoing projects, that will be visited during the tour, are presented here:

Grand Ethiopian Renaissance Dam (GERD), Bottom outlets

The hydropower project GERD is under construction since 2011 at the Blue Nile. With 6000 MW installed capacity it is going to be the largest hydropower plant in Africa. The 165 m high RCC (roller compacted concrete) dam is equipped with two identical bottom outlets. The fully armored bottom outlets feature several profile transitions and both end in flip buckets which divert the water into the stilling basin. A 1:29.7 scale model is built to optimize the hydraulic design of the bottom outlets and to investigate scour development in the stilling basin.

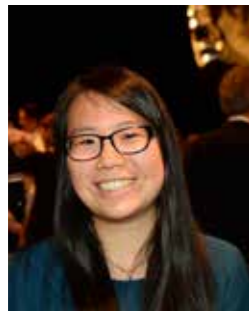
Sihl River culverts at Zurich main station

Essential parts of downtown Zurich are located on the alluvial fan of the Sihl River, a gravel-bed river from the Swiss Alps that carries high sediment loads and a considerable amount of driftwood. The main bottleneck concerning the discharge capacity is located at Zurich's main railway station, where the Sihl crosses the station through five culverts. The culverts are prone to driftwood and floating debris accumulations and possible sediment deposits or obstructions.

These complex flow patterns and transport processes are investigated at VAW of ETH Zurich using a hydraulic scale model of 1:30.

Participants

CASE STUDY 1 | WATER AND HEALTH



Alice Chau

Chinese is my mother tongue but don't expect me to speak it without an awful French accent. Or more precisely, an 'accent Vaudois'. I grew up

on the shores of the Geneva Lake, and peaceful and comfortable was my childhood. Being an immigrant kid has given me a strong awareness of inequality and privilege questions as well as a certain sense of humility towards nature and humanity. We all belong to one world, live on one earth, but I have the impression that this is often forgotten in our (Western) society. This is why I stand for education and a minimum life standard: it is when you don't need to care about your basic needs anymore that you can think in a holistic way of a better future. And if I am fascinated by the deep mysteries of the Universe, I truly believe in humans. Scientists have their own task to solve: how to share their knowledge in the most meaningful way to the rest of society, and not only for technological and quantifiable applications. Somehow this Winter School will give me some clues.



Capucine Musard

After a bachelor in Food Sciences at the ETH Zurich, I started my master with an exchange semester at the National University of Singa-

pore and a journey of 3 months across Southeast Asia. I decided then to do the specialization of my master in Nutrition, Health and Environment at the ETH Zurich. I got the opportunity to do my master thesis in collaboration with the Swiss Tropical and Public Health Institute of Basel on schistosomiasis and fascioliasis, two parasitic diseases transmitted by freshwater snail vectors, with a fieldwork of two months in Ivory Coast. This is where I started to get really interested in water challenges. I wish to learn sustainable solutions and innovations that will enable to improve the health of the population regarding water issues. I am also looking forward to meet amazing people from all over the world and share with them our different experiences.

CASE STUDY 1 | WATER AND HEALTH



Dwica Wulandari

Hello from Indonesia! I believe that the importance of the environmental ecosystem is crucial for the survival and existence of our earth and

life. This especially drives me to study an environmental engineering major in hopes of making the difference of the environment in the near future to make a better place for people, particularly in my country. I am aware that the ETH Zurich Winter School 2015 which consists of a mixture of lectures, workshop and several excursions is very helpful to me to broaden my knowledge in global water challenges. I hope this program will provide me essential knowledge with innovative approaches in the water issues. Moreover, it will be one of the most eye-opening and worthwhile experiences that are possible to have. Furthermore, sharing and learning experience with other Master and PhD students from different disciplines will be a priceless experience for me. It will be a good input for me building original research to solve water problems in Indonesia. My interests: reading, travelling and snorkeling. Getting a diving license is one of my bucket lists because Indonesia's oceans are just too fascinating.



Evangelia Prentouli

Water is a great treasure on Earth. Everyone must have access to clean water - it's a source of good health. As a geologist, I believe and I hope I can help with my work

for a planet better and more welcoming planet for all of us. I have a broad interest in geosciences and environmental sciences, so I have worked in various fields. I love to travel and I have traveled a lot during my studies. Meeting new people, different cultures, gives me a wider perspective; it gives me a better understanding of our world's needs. I'm looking forward for this Winter School, that would bring all our ideas and opinions together, from all over the world.

Together, I expect we will manage to cooperate through different fields of science and make suggestions for matters concerning international issues of sustainability and wellbeing.

Participants

CASE STUDY 1 | WATER AND HEALTH



Leila Schneider

I am currently doing my Master at ETH Zurich in Environmental Sciences with a major in Biogeochemistry and Pollutant Dynamics. Traveling and volunteering around the

world made me aware of the challenges our planet and society are facing. My interest in the environment comes from its interdisciplinarity and connections with many societal and economic issues too. Their complexity and influences on so many aspects of human life such as agriculture or health made me want to focus on water challenges. For me the winter school is an opportunity to widen my acquaintance of this subject by having contact with experts directly involved in this field and by sharing interdisciplinary knowledge. I also hope to work out concrete and applicable solutions in the case study. I am looking forward to sharing interests and experiences with people with different backgrounds and from all over the world.



Roza Yazdani

Hi! My name is ROZA. I am a doctoral candidate in Water and Environmental Engineering research group at Aalto University, Finland, where I am doing my PhD research

on low-cost approaches for removing arsenic from drinking water supplies. As a PhD researcher, I plan to build an international career in the field of water and environmental engineering, so this programme would mean a lot for my professional aspirations. I am confident that the opportunity of attending the E4D programme broadens my horizon further and gives me a chance to enhance my world class knowledge and help me become an excellent researcher in the field. I am interested in theme 1 "Water and Health" of the programme. I find it interesting that not only is the case study about developing an integrated WASH programme for schools in Bolivia which is suffering from arsenic contamination in its ground water supply, but it is also including field study and lab test. It has been a long time that I was searching for such an educational-investigative programme. In fact, it can help me to achieve both broadening my knowledge in water and health science and applying this knowledge in my native country, Iran, where mostly people are suffering from a lack of proper drinking water treatment.

CASE STUDY 2 | WATER AND FOOD



Abebe Guadie

I am very excited to participate in the Engineering for Development (E4D) Winter School. I think it will be three weeks of hard work but also a great opportunity to share

culture and knowledge with people from all around the world, to have proactive workshops for a sustainable behavior and manage solutions to global water challenges.

This program would also be an excellent opportunity for me to investigate and analyze the future water problem issues, solutions, and I will learn about the complexities of water policies and I will be challenged to assess technological solutions in a broader societal context. I am looking forward to learning from all the participants as well as the various speakers who also share the common interests in water challenges!

I also hope to receive a deeper insight on what motivates people to be physically active and finding smart solutions for motivational challenges which we are facing when talking about water challenges today. This will build on my knowledge on hydrology and water resources management related courses. Learning more about the water dimension is essential in the re-examination of our food, water, and energy systems as a global inter-connected web.



Anna Behmer

For me, like my study programme shows, water was and is a fascinating subject, which will become more and more importance in the future. I never could limit

my interests to one single subject. I think, we all are responsible for our planet and water has a huge influence to life and environment. Therefore my study programme and also this winter school offer me a great opportunity to put my knowledge and some of my interests into a bigger context with links to big problems that challenge mankind. I expect, working in such mixed groups will be a nice way to expand knowledge, since we all will have different backgrounds, but also to get in contact with other cultures and ways of lifestyle, what really interests me. But I do not only exist as a student, in my free time I love sports e.g. riding, boxing, dancing & running. I enjoy baking and reading books and I'm always curious to test new stuff and to see new parts of the world, since my personal world map has so many white spots.

Participants

CASE STUDY 2 | WATER AND FOOD



Bidur Khadka

Currently, I am a Graduate Student in Yokohama National University, Japan originally from Nepal. I am studying here governance issues on natural resources

management (Common Pool Resources) such as in community forestry, water resources, Satoyama concept etc.

Before starting graduate school in Japan I worked for a couple of years in different organization on projects such as Community Forestry, Livelihood Forest program, Reducing Emissions from Deforestation and Degradation plus etc. I hope to gain more knowledge and new concepts on water governance and diplomacy from this winter school. The meeting with friends from different country and academician from renowned institutions will be also wonderful. Moreover, I am also interested in hiking, traveling, bird watching and playing Chess. I wish this winter school be a good start for us to tackle current global water challenges.



Katharina Höreth

I am looking forward to get in touch with fellow students, all with different background and knowledge, but highly motivated to work in the field of water and development.

Through learning from experts and their expertise, I expect to get a deeper insight view in the water and health, food and energy context.

My wish is, to work on the real case scenario by delving as a team into it. By defining our goal together and working on potential solutions, I expect to understand first-hand some of the potential challenges appearing in water, food and development context. After completing the Winter School, I hope to be a little more experienced and self-confident to deal with the potential challenges rising in the water and development sector and to feel more prepared for future tasks in this field. Furthermore, I would be very pleased to participate in a platform, where we could exchange each other's experiences in the long-term, as well as help us and give critical feedback, in cases when it is needed.

CASE STUDY 2 | WATER AND FOOD



Kedir Mohammed

I am Kedir Mohammed from Ethiopia; I am working as Senior lecturer in Arba Minch University in the Department of Water Resources and Irrigation Engineering. I am

involved in research and project works related to: Spate irrigation and food security, water management, Application of GIS and remote sensing for integrated water resources management, etc.

From the Winter School, I expect that it will be a good experience for me with outstanding facilities: including laboratories, demonstration projects and smart professors to teach in addition to its suitability for international students. I wish, the winter school may become pioneer in the entire globe and will be number one outreach for international students and global organizations



Pierpaolo Scaggiari

After graduating in Civil Engineering I worked in several places, in a wide range of positions, but I never stopped searching for my deepest aspiration that I finally found

out: working for the development of the natural resources for humanity.

I applied to this Winter School because of my interest in gaining new knowledge that I can use in my present work and my future plans. The role of an Engineer is solving problems as well as inventing new technologies, so I would like to face the challenges of both management and creation of water supplies, with a particular focus on water for food, that will be one of the world's most important needs in this century. This Winter School will be a great chance to learn from a wide range of different abilities, knowledge and ideas, so I bet I'll get a strong base of useful competences and I'll know interesting and stimulating people.

Participants

CASE STUDY 2 | WATER AND FOOD



Rajat Kumar Panda

I am pursuing my doctorate degree on water resource at IIT Bombay, India. I began my educational career in Earth Science (Geology) under Bachelor and Master's program.

My current interest is on the water resource assessment under different climatic conditions especially on water scarce region.

I hope to learn the adaptation of scientific, cultural and logical water allocation strategies in a dominated surface water irrigated river basin with the control measures on the salinity of fertile lands. I hope that the Global Water Challenges program will broaden my vision of understanding about water and food related issues.



Ruoji Luo

Hi, everyone. My name is Ruoji Luo and I come from China. I have finished my bachelor course "Water Science" at the University of Duisburg-Essen in Germany

and now I am studying the master course "Water Science" at the same university.

As the name of my study course already reveals, I am dealing with water orientated lectures. My lecture courses are so interdisciplinary that each student can gain knowledge about microbial and chemical properties of water, water and waste water treatment. My focus lies on the chemical behavior and analytical determination of micropollutants in water, like groundwater, surface water and waste water. Because the group members of the winter school "Global Water Challenges" come from different countries, I hope I can join the group quickly and get more information about how water (drinking water and waste water) is treated worldwide. During the winter school I hope I can fill my gaps regarding to the topic water theoretically and practically and I really want to visit Eawag,

CASE STUDY 3 | WATER AND ENERGY



Alessio Ciullo

Hi ! My name is Alessio, I am 23 years old and I come from Italy. I am currently a second year Master student in Environmental Engineering but I haven't decided yet what to do

in my life. Engineers are usually fast thinkers and get straight to the point and there should be something wrong with me. I was torn between travelling to Alaska or Brazil when I found out about the possibility to apply to this Winter School. So I did ask myself: why not Zurich?

I really think this short-course can be a great opportunity from both a personal and professional point of view. I have always had a huge interest in water challenges and sustainability in a broader sense. I am sure this programme will help me to deepen such issues and I am looking forward to starting and getting in touch with all other participants.



Allison Jacobson

I am very excited to attend the E4D Winter School 2015! My research interests are focused on the resilience of the environment in response to human action. Before

starting graduate school I worked in the Mojave Desert (southwestern United States) completing habitat restoration projects in wilderness areas impacted by off-road vehicle use. Since starting graduate school, I have become interested in the restoration of rivers and streams. I am currently working on analyzing restoration effectiveness, mainly focusing on geomorphic response, at Muir Beach in Golden Gate National Recreation Area, California.

In the winter program, I hope to learn more about the impacts of dam construction on ecosystems and communities. I am looking forward to participating in an international and interdisciplinary team to address these issues, and I am eager to contribute to research that will create a multifunctional approach to river management that incorporates improved livelihoods, living conditions, economies, and functioning ecosystems.

Participants

CASE STUDY 3 | WATER AND ENERGY



Carmen Iten

I started my studies in mechanical engineering with the goal of finding a job in renewable energy production. Only looking at technical solutions has however never

been satisfying enough for me. The challenging work on improving cooking stoves in Nicaragua showed me that understanding the local culture is at least as important as having powerful technology. During my master at ETH Zurich, I not only enrolled for engineering courses in energy technology, but also took classes related to international development in the environmental engineering and food science departments.

During the E4D winter school I would like to discuss the opportunities and risks of development aid, especially as an engineer. I hope to meet more people that are passionate about international development because an interdisciplinary approach is key to solving the big challenges of our time.



Demelash Wondimagegnehu

My name is Demelash Wondimagegnehu and I am a lecturer at Arba Minch University, Ethiopia. I am interested in participating in this Engineering for Development (E4D)

Winter School because I was particularly intrigued by the innovative use of robotic technologies in the water and energy sector. Therefore, I am applying to this program to get multidisciplinary professional growth, technical and managerial skills in the area of Global Water Challenges in the winter school program in Engineering for Development.

Throughout my MSc studies in Hydraulic and Hydro-power Engineering, I realized the challenges of sustainability and future energy are frequently debated and discussed among these and other disciplines. Therefore I anticipated discussing and expanding my understanding of these ideas through the interdisciplinary approach in the case studies. This program would also be an excellent opportunity for me to investigate and analyze the future water & energy issues, solutions, and technology innovations. I am looking forward to learning from all the participants.

CASE STUDY 3 | WATER AND ENERGY



Fatma Ezzahra Maatar

First of all, I would like to say that I am glad to have the opportunity to participate in the E4D winter school "Global Water Challenges".

From this program, I am expecting an enriching experience that will allow me to know more about global water challenges and that will give me the possibility to really help people needing the knowledge I could gain from this experience added to my background. I am happy that this program is giving me the chance to meet people from all over the world and especially experts who can teach me from their experiences. I hope that the lectures and the workshops will make the participants of the three teams able to assess technological solutions for the suggested case studies and further cases that we could encounter during our professional life.

To recapitulate, I hope that through this E4D winter school, as planned and described, we will reach successfully the goal of the program which is finding practical solutions to try to improve the livelihoods of poor people in developing countries.



Leonel Reyes Ochoa

My interest on sustainability led me to study more into detail the field of power generation, specially from renewable energies. For the last months I have been

working in my master's thesis regarding power generation with solar- and bioenergy. This project has let me know more about some technical challenges concerning sustainable development.

Now, I am looking forward to learn more about water challenges around the world and I believe that this Winter School will give us the opportunity to gain experience evaluating the environmental, social and economical impacts in real scenarios. Furthermore, I hope that we can broaden our knowledge on different topics by sharing the results achieved by the three work groups.

I feel very motivated to be part of this course at the ETH Zurich. Since traveling and learning from different cultures are my passion, I am certain that this international group will contribute to create a great work atmosphere.

Participants

CASE STUDY 3 | WATER AND ENERGY



Mohammad Hatamjafari

I am passionate about music and travelling. Considering that I know a little about water, the most memorable moment of my travelling so far was walking along Rhine

in Germany and wandering around Amsterdam canals listening to music. What a lovely combination! I hope I could also have the same experience in Switzerland.

I believe the winter school would be a perfect chance for me to enhance my knowledge in integrated water resources management with which it is possible to tackle complex water-related problem especially in developing countries, where identifying actors sometimes is not as easy as in developed countries.

I am also so happy that I can chat with students from all over the world. I love to know about foreign culture and lifestyle. I am looking forward to learning more about your country, your culture and your lifestyle as well as your views about life. The key to a better future is international collaboration so let us bridge the gap.



Santosh Neupane

Well, the E4D winter school is a good opportunity for an early career researcher in the field of water management, environmental hydrology

and energy nexuses. I think, it will provide a common platform to enhance knowledge in global water challenges. I don't expect more but ideally it adds one step ahead in my academic carrier. This is because a water and energy nexus is a prioritized sector in case of Nepal, Himalaya. So my expectation from this winter school is to sharpen my research capacity in water challenges in regional as well as global scale linking different aspects.

I wish this program can cover the different aspects of water challenges in regional and global scale. It could help us to identify water challenge issues and enhance management skills in different scenarios. And, my wish is that it can help to develop an international network of young researchers to make coordination in the field of water challenges and continue different initiatives.

CASE STUDY 3 | WATER AND ENERGY



Stephen Siwila

I wish to acquire advanced knowledge and build a professional network that will enhance my quest to promote and contribute to policies and methods relevant for water

and energy management and exploitation in Zambia's Kafue river basin and the rest of the world, subsequently improving the livelihoods of the poor people.

Furthermore, I am highly expecting to get an in depth understanding of the water-energy nexus concept and how it is being implemented in other countries and learn how to promote it in my country. I am very eager to learn more about water and health, water and energy as well as water and food engineering, scientific and policy principles from the well learned and experienced professors. Additionally, I wish to possibly get connections for potential PhD funding under the "Engineering for Development (E4D) doctoral scholarships" so that I could with every effort explore the water-energy nexus in the Kafue river basin, Zambia, in a more advanced manner and present findings at both local and international fora.

Besides, I wish to learn many and great things from each of the proposed field trips e.g. "Visiting the Underground Sewage Water System in Zurich" and how well I can utilize such precious exposure in my work and profession. Finally, from the group works I am expecting to learn a lot of things from my colleagues in each task and how well we can all contribute to tackling global water challenges.



Tiziana Smith

I am a second year Master's student at the Massachusetts Institute of Technology where I study Environmental Engineering and Technology and Policy. My research at MIT

focuses on understanding the constraints of land and water availability on food production in China.

My professional interests lie in the intersection of environment, water management, and economic development. Before graduate school, I spent two years at the World Bank in Vietnam working with the government from central to local level on climate change policy development and on water resources management projects.

In addition to learning from the lectures and speakers, I expect that this winter school will be a unique chance to meet other young people interested in water and to learn from their experiences. I'm very excited to meet all of you in just a few weeks!

Organization Team



Dr. Barbara Becker

Barbara Becker is Director for Global Transformation Affairs and as such member of the Management Team of ETH Global. Formerly, she has been Managing Director of the North-South Centre of ETH Zurich, a competence centre dealing with research for development (R4D). Her professional background is tropical agro-ecology. Barbara Becker obtained her habilitation at the University of Kassel, Germany. She gained international experience as UNEP field project officer, where she investigated the vegetation ecology of Andean land use systems in Peru. Her doctoral research focused on edible wild plants in Africa.



Dr. Darcy Molnar

Darcy Molnar is coordinator of the Master of Advanced Studies (MAS) in Sustainable Water Resources, at the Institute on Environmental Engineering ETH Zurich. Prior to this role, she was the recipient of a SNF Marie Heim-Vögtlin grant to study and model rainfall runoff regimes in Swiss alpine catchments, at ETH Zurich. Before moving to Switzerland, Dr. Molnar spent a year at the Slovak University of Technology in Bratislava Slovakia, as a NSF-NATO Post-Doctoral Fellow. She attended Colorado State University (USA), where she received a PhD and MS in Civil Engineering, and Middlebury College (Vermont, USA) where she studied Physics with a concentration on Third World Development. Having spent her childhood years in West Africa, Dr. Molnar has a keen interest in development issues and currently focuses her professional activities on topics related to research for development and capacity building.



Catherine Lippuner

Catherine has been a part of the ETH Sustainability team since May 2009. She's primarily responsible for education projects, among them the ETH Sustainability Summer Schools. Before joining ETH Sustainability, she worked for the Swiss Green Party, the Center for Health Policy and Public Health in Bucharest, Rumania; the London School of Hygiene and Tropical Medicine in London, UK; the Royal Tropical Institute in Amsterdam, the Netherlands and an HIV/AIDS clinic in Valencia, Venezuela. Catherine completed her studies with two Master's degrees in microbiology from the University of Zurich and in international public health from the Free University of Amsterdam. Besides her work at ETH Zurich, Catherine is a freelance yoga teacher and Shiatsu therapist.



Maria Ubierna

Maria is currently involved with the organization of the E4D Winter School "Global Water Challenges" and internal supervision of the case studies water-energy and water-food. Since the first year of university in Spain she has been volunteer at Engineering Without Borders NGO, involved in organizing conferences about education for development and appropriate technology for developing countries, in particular in the water section. In pursuit of a deeper knowledge about sustainable water resources worldwide, she came to ETH Zurich. Before coming to Zurich, she was working in a management consulting firm, Accenture, in Madrid. She has a keen interest in the interrelations between private sector, NGOs, universities and institutions to develop sustainable solutions for one of the most valuable resource on earth, the water.



Cyrill Zosso

This fall Cyrill started his Master's degree in Environmental Sciences with the major in Biogeochemistry and Pollutant Dynamics at ETH Zurich. Coming from a gap year where he did his civil service working on a farm, at Zurich School of Applied Sciences as a project assistant and in a bird protection project, he is now enjoying university again. Apart from university, he enjoys playing badminton, has a strong affinity to nature and would love to spend more time with reading books that pile up next to his bed.



Catherine Ikae Omal

Catherine received a Bachelor of Information Technology and Computing from Kyambogo University in Uganda 2008 and a Msc Computer Science from Makerere University in Uganda in 2013. She has spent one year in the Wearable Computing Group of ETH Zurich while working on a ICT monitoring service delivery system in the water sector in Uganda. Ikae's interests are in machine learning, computer vision and image processing, and particularly in the use of these in developing countries to address problems in health, resource monitoring and sustainability.

Being part of the Artificial Intelligent research group in Makerere University enabled her to realize that there are many sectors where these computing techniques can be applied to save time as well as improving the quality of life of the people.



Hannah Lea Dykast

Hannah holds a Bachelors Degree in Communication Design & Technology and Media Sciences from Parsons The New School For Design, New York. Hannah's work is mainly driven by transdisciplinary intersections between science, technology and design. As a freelance health coach and yoga teacher her focus on health and well-being of body and mind are a deep passion. Her current master thesis project is emerging in the field of emotional intelligence, wearable interfaces and experiential design.

Supervisors Case Studies

WATER AND FOOD



Gianni Pedrazzini graduated as an Environmental Engineer from ETH Zurich this summer and started his PhD right afterwards. He is working on the issue of groundwater depletion and irrigation water

allocation in the context of a project in the Heihe River Basin, an inland river basin in Western China. The point of departure in this project is of similar nature as the case study on water allocation for food and ecosystem health: the struggle for the scarce resource water in arid environments being the seed of the problem. Thorough understanding of stakeholders' interests and ecological needs in combination with modern scientific tools nowadays allows better exploration of management strategies and its impacts than in the past.

WATER AND ENERGY



Daniela Anghileri is a Postdoctoral researcher at ETH Zurich, at the Institute of Environmental Engineering. She holds a Master degree in Environmental Engineering and a PhD in Information Technology (obtained within the

section of Systems and Control Engineering) from Politecnico di Milano, Italy. Her research activity is focused on system analysis and multi-objective optimization applied to modeling and control of water systems. Her research is characterized by the combined use of modeling and optimization techniques to describe the complex interactions between the social, economic, and environmental aspects of water management, thus gaining information relevant for the decision makers in the context of Decision Support Systems. More specifically, she has mainly worked in the fields of hydrological modeling, reservoir management, and climate change impact assessment on water resources.

During the winter school, she will supervise the students on the topic of Water & Energy. In the class, the pros and cons of the construction and operation of hydropower reservoirs from a multi-objective perspective will be highlighted, focusing not only on hydropower production, but also on environmental conservation, irrigation and municipal water supply, as well as on water quality. The class will also illustrate how to quantify the effects of different reservoir regulation strategies, as well as explore how to negotiate a compromise between conflicting objectives.

Supervisors Case Studies

WATER AND HEALTH



Fabian Suter is researcher on water supply, water treatment and hygiene behavior at the Department of Water and Sanitation in Developing Countries (Sandec) at Eawag (Swiss Federal Insti-

tute of Aquatic Science and Technology). In the past years he has been active in projects with a focus on household water treatment and safe storage in rural areas as well as school settings in Kenya and Bolivia. He is also in charge of the department's e-learning platform and has structured and coordinated the newly developed Massive Open Online Courses (MOOC) at Sandec in collaboration with EPFL, on Household Water Treatment and Safe Storage as well as Sanitation Planning. His research experience is based on projects in various countries of Africa and Latin America.

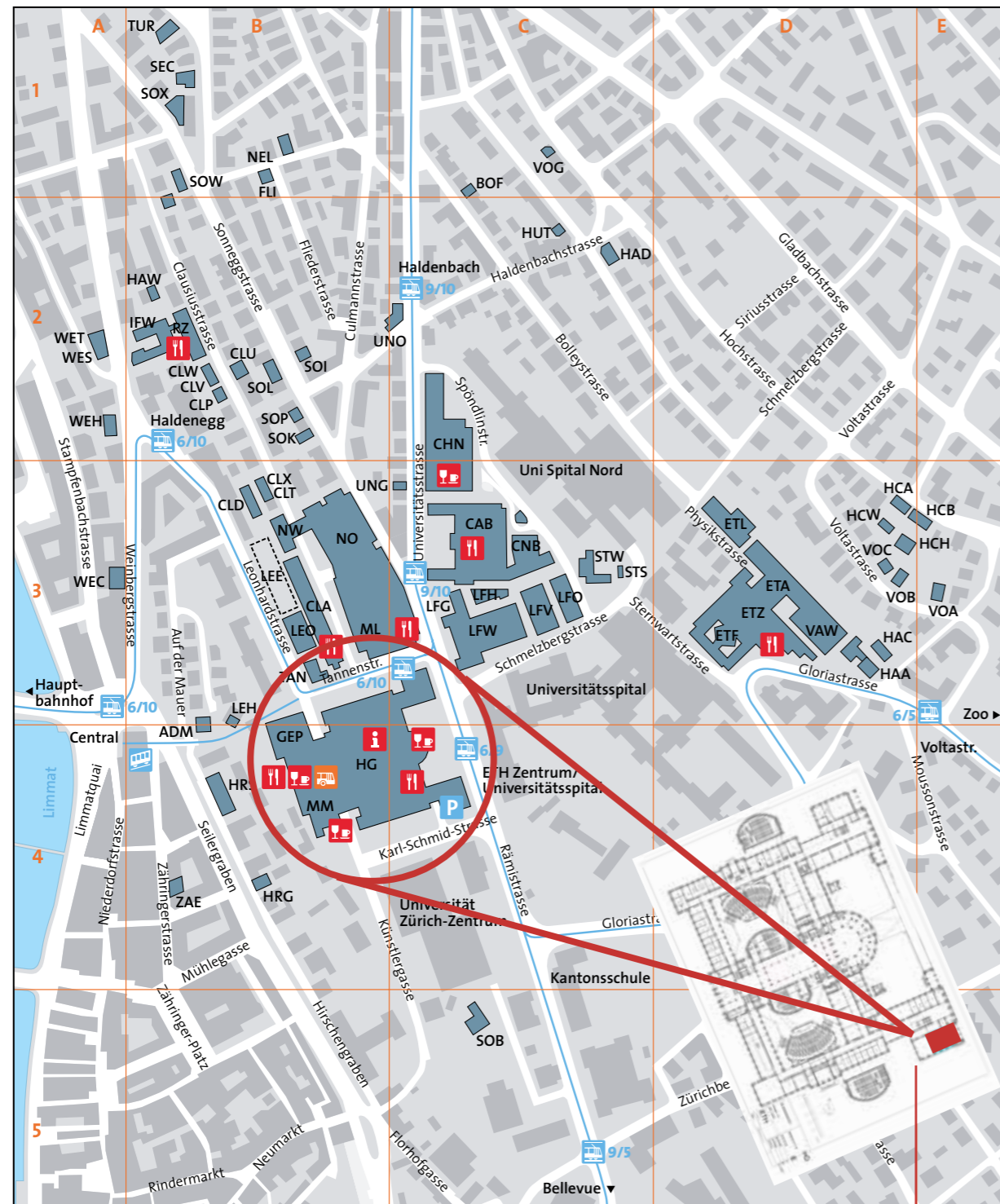
WATER AND HEALTH



Matthias Saladin is an Environmental Scientist and Engineer with thirteen years of experience in the water and sanitation sector. Much of his work so far was dedicated to research and research communication - as

well as policy development and advocacy - in the sector of household water treatment and hygiene promotion. He also has experience in product development and field testing in Bottom-of-the-Pyramid markets. For more than ten years, he has been involved in management and strategic guidance of non-profit organizations and social enterprises. Previous employers are the Swiss Federal Institute of Aquatic Science and Technology (Eawag) and the SODIS Foundation (www.fundacionsodis.org), among others. As an independent consultant he provided technical and methodological expertise to projects in Bolivia and Thailand. Matthias has been studying, living and working in Bolivia, Nepal, Spain, Switzerland, the UK and the USA and fluently speaks English, Spanish and German.

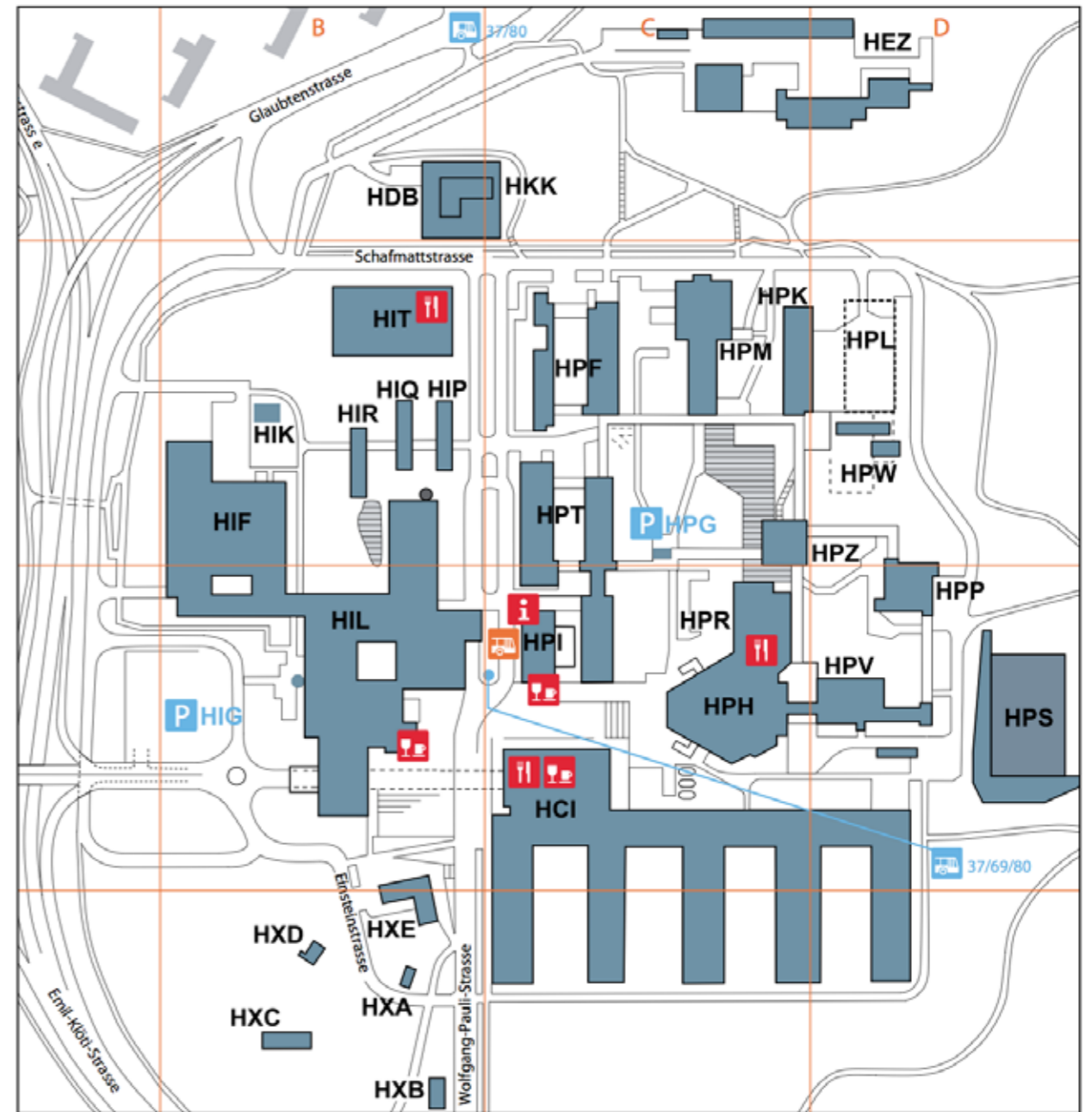
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Further information about the Winter School can be found under:
 E4D Winterschool → <https://www.ethz.ch/en/the-eth-zurich/sustainability/education/summer-and-winter-schools/engineering-for-development--e4d-.html>

Notes

Notes

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