Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	**Sanne Carmen Jet van Rees**
Student number	4855795

Studio		
Name / Theme	Metropolitan Ecologies of Place	
Main mentor	Alexander Wandl	Environment and Technology
Second mentor	Victor Muñoz Sanz	Urban Design
Argumentation of choice of the studio	As an urbanist, I am interested in working with complex challenges that show effects from the global to the local scale. I am particularly interested in climate change related topics and the human-nature relationship. The project is addressing climate change and environmental degradation issues by looking at the water system as an integrated system of socio-ecologic, political and economic factors. The systems perspective and flow analysis methods of the MEP studio match the approach of the research. Because solutions are sought though systemic design approaches and include technological solutions, the fields and topics of the studio match as well.	

Graduation project	
Title of the graduation project	**Ripples of Resilience**: a symbiotic design of the water system to combat water scarcity in the Segura River Basin, Spain.
Goal	
Location:	Segura River Basin, Spain
The posed problem,	**Water scarcity** There is a problem in arid or semi-arid regions, such as the Segura River Basin in Spain, with the availability of water and adjusting sustainably to a water scarce future. Despite efforts of the Spanish government to use new technologies such as desalination to increase the water supply in the region, climate change is causing long periods of extreme drought, resulting in an even lower availability of water. At the same time, an increase in water demand due to irrigation agriculture expansion, urbanisation and tourism in the form of seasonal peaks, are putting more pressure on the system.

	Overexploitation of water resources and drought have caused the mouth of the Segura river to drop to only 4% of its original runoff over the last years, stating the severity of water scarcity at the moment. The abundance of water has negatively impacted the citizens and farmers in the area in the form of rising water prices, more restrictions on water use and a decrease in agricultural produce, affecting the economy of the whole country of Spain. Thus, conflicts about the fair distribution of water arise because the different sectors are competing for the available water. At the same time, the lack of water causes a deterioration of the landscape, declining ecosystem services and ecological surplus, resulting in a point of no return: desertification. A possible cause of these problems is the compartmental and centralised water management system, a result from a history of profit-driven national regimes (Fornés et al., 2021, Lopez-Gunn, 2009). A metabolic rift has caused a change in the relationship between humans and nature, resulting in irresponsible, non-resilient and inefficient water use and management. The ecosystem is declining, as available water is distributed and used to the maximum and in an inefficient and careless way, overexploiting natural resources and polluting them at the same time (Zimmer, n.d.). The challenge of the Segura River Basin to adapt sustainably to a water scarce future is underpinned by socio-ecological issues that are deeply rooted into the socio-political context. Particularly the agriculture sector is in need of transformation. Water scarcity in the SRB is created and intensified by (a history of) unsustainable agriculture practices and poor, compartmental water management strategies, and underpinned by the economic growth paradigm that is characterised by a changed relationship between humans and nature. Perhaps a study which implements *symbiotic design principles* to create connections between the different sectors within the water system, in the form of a regional spatial strategy, could contribute to a sustainable water system in the region of the Segura River Basin.
research questions and	<u>Main Research Question:</u> "How would a Symbiotic Regional Design Strategy for the water system remedy water scarcity and contribute to a sustainable and socio-ecologically resilient future for the Segura River Basin?" Sub Research Questions: 1. "What elements, processes and interrelations define the water system in the Segura River Basin, and how

	have governance structures historically influenced its resilience?" 2. "What design solutions for sustainable agriculture, integrated water resources management or ecological restoration in water scarce regions are known?" 3. "What extreme futures for the region that address the water scarcity differently, can inform symbiotic design principles?" 4. "What optimal future vision for the region can be derived from assessing and integrating the conclusions from the extreme future scenarios?" 5. "What regional spatial design strategy focussed on symbiosis through sustainable agriculture and water management in the Segura River Basin can be created from the operationalisation of the vision?"
design assignment in which these result.	The project aims to redesign the water system of the basin from the systemic design perspective of an urbanist. It presents a multi-scalar and multi-discipline transformation, as problems throughout the water system are interlinked between sectors and embedded in the socio-political context. Systemic analysis is combined with symbiotic design (combining human and nature systems) to create socio-ecological resilience, combating water scarcity in the region. The integration of the sustainable agriculture transition (on the demand-side) and the resilient water management transition on the supply-side of the water system are the specific focus of the design. The project results in the following outputs, corresponding to the sub research questions: Outcome of sub question 1: - A holistic understanding of the water system in the region, the existing problems and the current and historic context. - This results in leverage points for systemic change Outcome of sub question 2: - A catalogue of design interventions (for sustainable agriculture, integrated water management and nature restoration in arid of water scarce regions) Outcome of sub question 3: - 3 extreme scenarios for the future of the basin, seen from three different sustainable transitions of the water system (1) maximised water supply, 2) maximised water use efficiency, 3) maximised natural restoration) Outcome of sub question 4: - An optimal vision for the sustainable transition of the region, consisting of design goals and symbiotic (integrated, multi-beneficial) design solutions

	Outcome of sub question 5: - The final outcome is a regional spatial design strategy, consisting of a regional spatial plan, water governance policy recommendations, a phasing of interventions in time, and a visualisation of the implementations of the design interventions on the local scale, within the local context.

Process

Method description

The project is divided into several steps, following the main research method used. Each step is complemented by additional sub-methods. The main method used is the Maximisation Method. The steps of the research are: Analysis I, Analysis II, Maximisation, Optimisation, and Integration, and correspond to the chapters in the report. The main approach used is the Network Approach. The interrelation of the sub questions, outputs and methods used is explained in the methodological framework. The sub-methods per step of the research are:

Analysis I – sub question 1:
For the analysis of the current water system and its context of the Segura River Basin, Systems Mapping is used. The sub-methods are:

- Integrated Analysis for a socio-political (historic) context analysis, including: Literature review, Desk Research, Policy document review.
- Integrated Mapping & Spatial Analysis according to the Network Approach: using GIS spatial mapping, Drawing by Hand, Diachronic Mapping, Satellite Observations, Media Analysis and Fieldwork Analysis.
- Stakeholder Analysis
- Synthetic Mapping

Analysis II – sub question 2:
For the analysis of the potential design solutions, a Precedent Study is conducted. Additionally, Fieldwork will give extra insights.

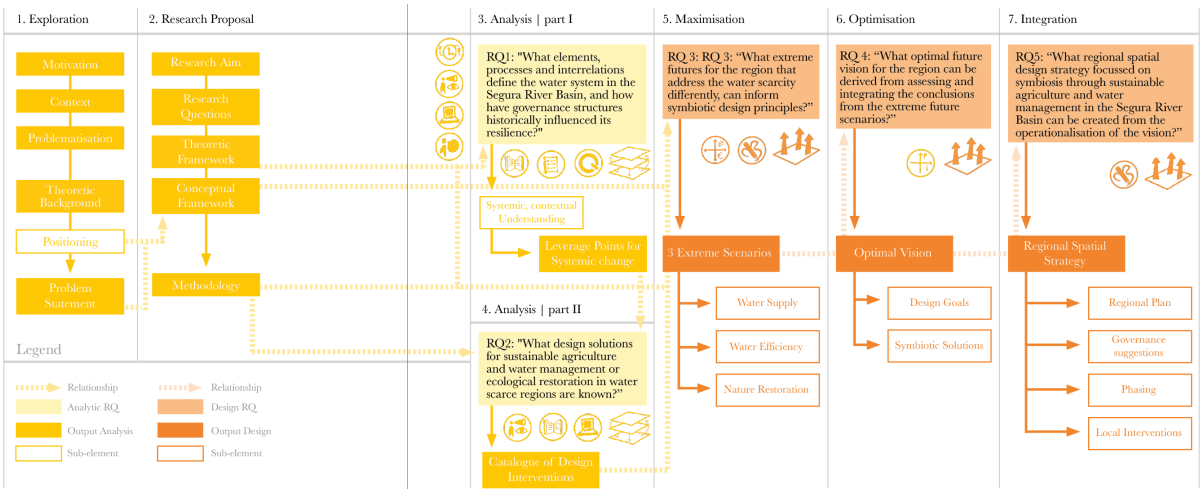
Maximisation – sub question 3:
For the Maximisation, Scenario Building in the form of extreme scenarios is used, as a part of the Maximisation Method. Additional sub-methods are Research by Design, Drawing by Hand and Collage Making. The scenarios follow from the conclusions of the analysis, and are constructed based on the Network Approach.

Optimisation – sub question 4:
The next step of the Maximisation Method is to assess and compare the results of the scenarios. The assessment framework used is the SIRIUS framework for sustainability assessment of (irrigation) agriculture, adapted from Antunes et al. (2017). The framework assesses four pillars of sustainability (environmental integrity, economic resilience and profitability, social well-being and good governance). The trade-offs lead to an optimal vision for the region. To visualise this, additional sub-methods are: Vision Making, Drawing by Hand and Collage Making.

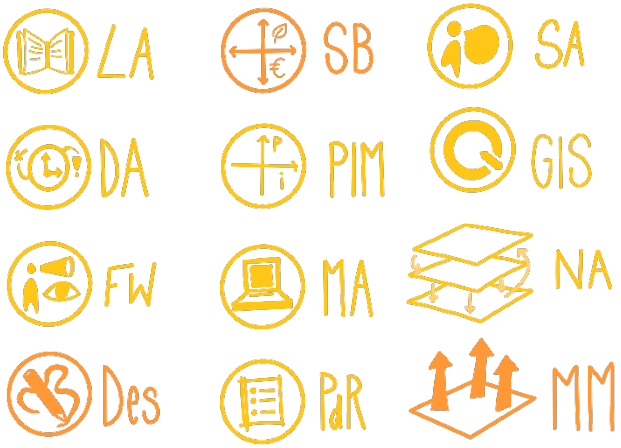
Integration – sub question 5:

For the translation of the vision to a Regional Spatial (and Symbiotic) Design Strategy and its components, Strategy Making, Visioning and Feedback Integration are used as sub-methods.

Methodological Framework:



List of methods and sub-methods:



LA = Literature Analysis
DA = Diachronic Analysis
FW = Fieldwork
Des = Drawing by Hand, Research by Design
SB = Scenario Building
PIM = Power Interest Matrix
MA = Media Analysis
PdR = Policy document Review
SA = Stakeholder Analysis
GIS = GIS spatial analysis and / or mapping
NA = Network Analysis
MM = Maximisation Method

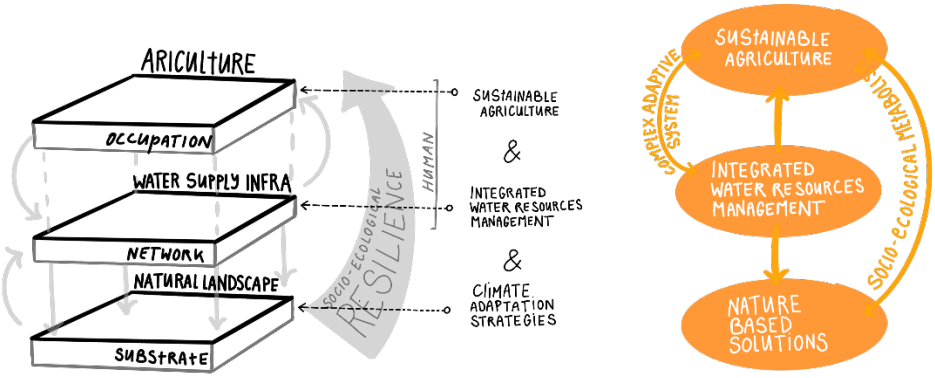
Literature and general practical references

The main theories used for the system analysis that are derived from literature are:

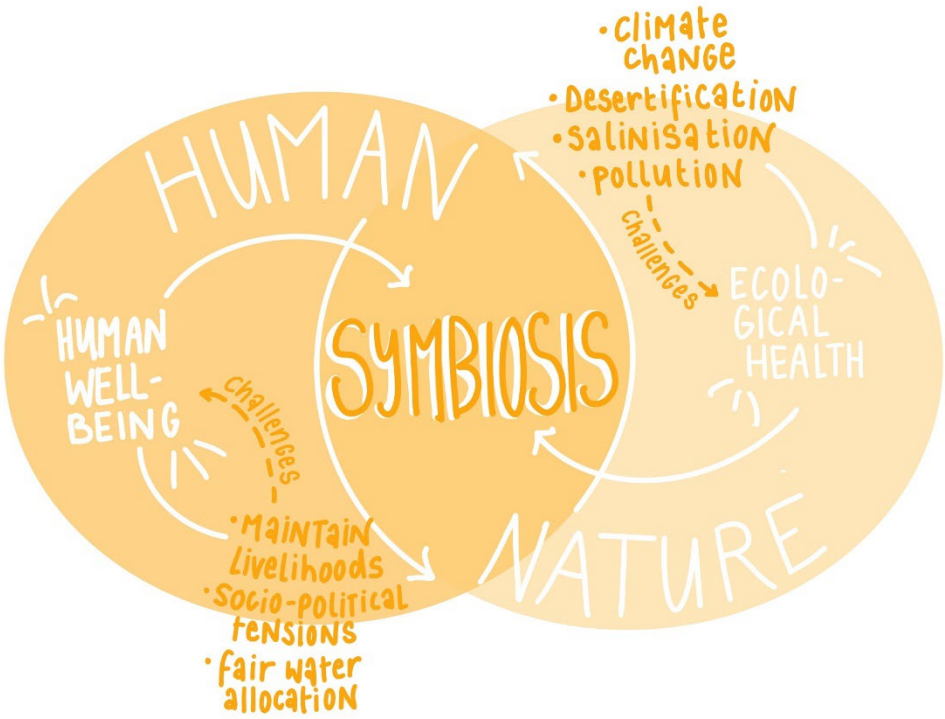
1. Systems Theory: Socio-ecological Systems Theory (Berkes & Folke, 1998, Ostrom 2009), Complex Adaptive Systems (Holland, 2006, Rammel et al., 2006).
2. Resilience Theory: Socio-Ecological Resilience (Holling, 1973, Walker et al., 2004, Folke, 2006).
3. Panarchy (Gunderson & Holling, 2002)
4. Metabolism (Swyngedouw, 2006): Territorial Metabolism
5. Integrated Water Resources Management (GWP, n.d.)
6. Critical Socio-environmental Theories: Political Ecology, Metabolic Rift Theory (Brenner & Katsikis, 2020), Critical Resource Geographies, Anthropocene (Ellis, nd., Ibañez & Katsikis, 2014) and Capitalocene (Marx, 1977, Moore, 2015, Sanz & Katsikis, 2024) led to the contextualisation of the problematisation and form the theoretic background.

The concepts used for the integrated approach of analysis and design are Systemic Design though the Network Approach (de Hoog et al., 1998, Priemus, 2004, Priemus, 2007, van Schaick & Klaasen, 2011) and Symbiotic Design (Horn & Proksch 2022a,b, Olivieri, 2022, Ruano, 2016, Poon, n.d.). The latter is derived from literature where it is applied in the field of architecture and technology, and redefined in this thesis to fit the regional scale and the complexity of the water system as a topic.

These theories, concepts and approaches are combined in the conceptual framework. The build-up of the conceptual framework is explained in the thesis report.



Conceptual Diagram Network Approach – Analysis & Design



Conceptual Framework

Literature and general practical references

Literature for the theories and concepts:

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

My thesis is about designing for a sustainable future water system in a water scarce region that is currently overexploited and heavily impacted by climate change. By investigating holistic solutions among sectors and designing for the implementation of these solutions in the local context, an alternative, more sustainable future is envisioned. Within the master track Urbanism, the power of narrative through spatial design is at the centre of the program. Urbanism is all about combining social, ecological, economic and political aspects of challenges in our environment though science and design.

The studio topic of systemic flows aligns with the topic and research perfectly, as the water system is examined as a complex adaptive, socio-ecological system. Additionally, technological solutions for sustainable water use and supply are researched and applied in the design, corresponding to the graduation track as well.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Research focus:
The outcome of this research is a spatial strategy for the sustainable development of the region of the Segura River Basin, that combats water scarcity and aims for socio-ecological resilience of the water system.

The focus is on fostering the transition towards sustainable agriculture and climate adaptation, in the form of a restored human-nature relationship. Technological and nature based solutions are integrated to form a symbiosis between anthropogenic activities and natural systems, incorporating principles derived from integrated water management strategies. A balance is sought between short-term needs and long-term urgencies.

Professional relevance - from an urbanist perspective:
The aim of reaching socio-ecological resilience in water scarce and arid regions that are (and will be even more) affected by climate change, requires a radial revisualisation of the water system as it is now. Reorganising the hinterlands of global food production in the form of fostering the sustainable agriculture transition, requires a spatial design task, as well as a water management transition towards integrated resources management approaches. As an urbanist, our role is to combine sectors and stakeholders and design for solutions though the scales and to bridge the gap between governance and the needs of stakeholders. With this project, I hope to provide an integral design strategy, inspiring other planners or decision-makers to approach analysis and design in similar ways.

Scientific Relevance:
The strategy can be implemented or used as inspiration for decisions by local decision-makers and regional actors such as the river basin authority or municipalities. Additionally, this thesis can form an inspiration for the sustainable development of and resilience planning in other (semi-)arid regions that face the problems of water scarcity and overexploitation of water resources.

Societal Relevance:
Next to policy makers and planners, the goal is to inspire other stakeholders and individuals (such as citizens and farmers) to adjust their water consumption patterns and think about a balanced relationship with nature. Water-related issues such as shortages do not only occur in water-scarce regions. Acknowledgement of water related problems is increasingly important in the globalised world we live in today. In order to achieve a changed relationship between humans and nature, social acceptance needs to be created and individual behaviour needs to change. Therefore, spreading awareness of these issues and solutions is crucial.

Limitations:
This research aims to provide policy makers, urban planners and other stakeholders with integral, socially and environmentally just and sustainable solutions, that are beneficial for multiple agents. However, designing for all elements of the water system is a complex task and goes beyond the scope of an urban designer alone, even as the timeframe of a masters' thesis. Based on the conclusions from the pre-analysis, the main design focus for the regional strategy lies on the transition of agriculture sector towards more sustainable practices. Further research could go more in-depth about the interrelation of the systems components, problems and solutions. Other case areas could be examined and compared, as well as other sectors such as the tourism industry.