



Delft University of Technology

Prospects for inquiry in Delta Urbanism research by design

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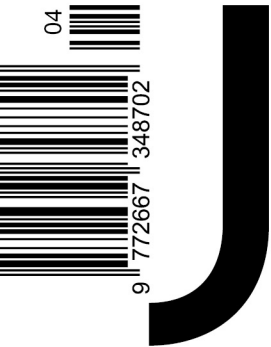
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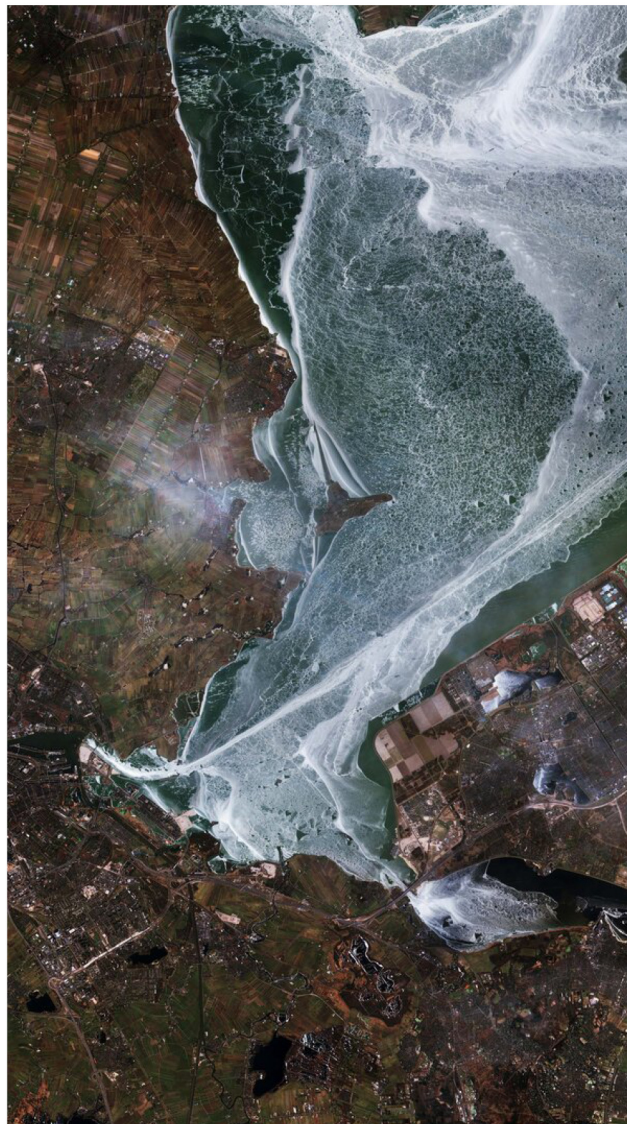
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*Prospects for inquiry
in Delta Urbanism
research by design*

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The undisputable human influences on the Earth's system demand an urgent change of ways and transitions in human systems to sustain a healthy society in the future. Addressing the urgent climatic transformations in deltaic areas, this paper is an attempt of the Delta Urbanism research group at TU Delft to set the line for new (integrated) research inquiries by design and investigate fundamental, experimental, and strategic & operational responses to the existing prospects for action as a way to create collaboration between various sectors. These prospects for action are targeted at four critical fronts (climate, urban, governance, cultural) based on trends and challenges that deltaic areas are facing and to which coherent spatial strategies are needed. These fronts together need a research response to enable the making of the delta of the future through the power of interdisciplinary design. This perspective or prospect is established through six lines of inquiry that are elaborated in the paper. The central question is “how can the research field of delta urbanism provide a transformative ‘prospect for action’ to establish strategic pathways toward a resilient Delta future, where assertion and proof are synergized”? The discussion of the six lines of inquiry, which effectively address the four critical fronts, explores how they are poised to deliver fundamental, experimental, and operational outputs for further research and action.

INTRODUCTION

Deltas have a long history of providing fertile livelihoods and economies all over the world. However, as settlement increased over time and human interventions intensified especially in maintaining the stability of the water-land conditions, these areas are faced with a growing complexity of the interdependent socio-ecological challenges¹. The accelerated population rise, which is often recorded under large-scale top-down investment patterns, puts pressure on both the availability and quality of land in deltaic areas. Changes in climate and the associated hazards and environmental disasters, such as flooding and sea level rise, have increased risks that threaten lives, land safety, infrastructures, homes, and the inhabited environment for both the humans and non-humans². The undisputable anthropic activity on the Earth's system demands a transition to establish a healthy society in the future. Adaptation to these challenges on the basis of climate projections, overcoming the deep uncertainty related to *known unknowns* and *unknown unknowns*, seems to be part of the prospect of action now. The question is if climate science and its numerical projections and simulations will be able to convince decision-makers to steer another course of action in time. Additionally, it raises the question of whether decision-makers will actively support a shift in approach or if they are entrenched in the current paradigm of prioritizing growth at any cost. The matter of fact is that already necessary transitions of global energy systems lag behind, with fossil-based economies continuing to dominate the main energy consumption scene³. Despite the fact that steps towards the development of policies are made, short termism and blurred accountability of policies hamper such efforts. Moreover, the difficulties of decision makers in accommodating change and uncertainty contribute to the gap of sustainable reactions⁴. In addition, the persistent and siloed disconnection between engineering practices and systemic socio-spatial approaches continues to follow a trajectory of protocolized responses. The protocolized approach is the current way of dealing with the complex tapestry, where each discipline takes its role and contribution independently to the whole. This approach struggles to cope with the required shift and ultimately fails, urging protocols to adjust and change. The disconnection is deeply rooted in cultural practices such as norms and values existing in governance and knowledge institutions⁵. Such organisations need to transform by questioning the way they work and the values behind what they do and how they do it. The transformation can lead to reversal of the lock-in effects of current economic trends impeding radical changes, boundary spanning, and intergenerational justice in climate adaptation⁶. Without cultural support, lack of awareness and readiness for societal change, transitions are likely to continue propagating existing path-dependencies in adaptation processes.

In the case of deltas, the urban landscape is a hybrid of interwoven natural and human systems, to the condition that Latour considers a tapestry of complexity that can only be transformed in an inclusive manner⁷. Change within complexities like the coexistence of stakeholders in such techno-socio-ecological systems requires a shared understanding, vision and strategy⁸. This is where design takes a role as a powerful transformative act. The role of spatial design is not perceived as the mere production of images for the future. The act of designing is meant as a fundamental tool to do research (by design) on possible futures in a systemic perspective that

- 1 Chen et al., 2022
- 2 Hill et al., 2019
- 3 World Economic Forum, 2023
- 4 Santos et al., 2022
- 5 Dodd et al., 2023
- 6 Mealy et al., 2023; Teodoro et al., 2023
- 7 Latour, 2018
- 8 Chester et al., 2023

specializes and negotiates many disciplines (boundary spanning). In this context, design is seen as an approach to ‘shared agency’ that is needed at all scales to open the discussion on transformation instead of incremental adaptation to the changing climate⁹. This way, spatial design offers alternatives, links scales of intervention, interests and guides the process. It is a key method to examine how delta management can be future-proofed to respond to uncertainty, climate change and competing land use claims actively and contingently. Due to its integrative, forward-looking nature focused on physical transformation and intervention, spatial design offers multiple action-perspectives, by balancing out claims and values which materialize in a new spatial composition and configuration. Change implies the evaluation of past and present forms of inhabitation, production and infrastructure in shaping deltas and a critical position on the role that spatial design has in delivering water (or flood) safety and security, ecological integrity, and socio-economic prosperity, while maintaining cultural meaning. This is a skill that guides collective thinking about future delta-management which is needed to give way to transformation in dealing with the environmental crisis and the changing climate¹⁰.

Climate transformation in deltaic areas therefore requires the emergence of new (integrated) research inquiries by design to investigate fundamental, experimental, strategic and operational responses to the existing prospects for action as a way to create collaboration between various sectors¹¹. The prospects for action of the Delta Urbanism research group are targeted to work on four critical fronts that are identified based on the afore-mentioned trends and challenges that deltas face: the climate front, the urban front, the governance front and the cultural front.

The *climate front* refers to the necessity of understanding and responding to the changing hydrological patterns of the deltaic conditions. This implies research on both the relation between the specific ‘dynamic’ state of the delta and its ‘linear’ surrounding conditions, for example, simulating sea level rise and river discharge, among other issues¹².

figure 01 — page 28



Action from the *urban front* requires an understanding of the dual forces of environmental degradation and the ongoing urbanization in deltas and the relationship between the ‘dynamic’ natural state of the delta and its ‘fixed’ urbanized areas. To synergize the urban front with the deltaic conditions, a shared, interdisciplinary strategy for adaptation and mitigation that embraces all approaches (retreat, advance, protect, accept) is needed¹³. In the Dutch context, this calls for the development of a new Dutch approach as an emerging concept of city forming and mitigating the demand for urban expansion.

figure 02 — page 28



- 9 Liedtka and Ogilvie, 2011
- 10 McPhearson et al., 2021
- 11 Psarra et al., 2021
- 12 Dash et al., 2021
- 13 Hadfield-Hill, 2020

The *governance front* tackles contextual and panarchical perspectives on decision making under risk and uncertainty and the deep spatial and inter-generational injustices involved. The main actions include changes in norms and values, regulatory frameworks, organisational frameworks, resource deployment processes, and exercise of power to cope with risk and uncertainties. It also involves the generation of insights on boundary spanning, and a better understanding of the changing systems and subsystems¹⁴.

figure 03 — page 29



On the *cultural front*, steps that address the lack of cultural response and accommodate societal change are necessary. The creation of open, dialogue based methodologies along with the generation of a new Dutch approach focusing on values and goals is integral. Understanding human behavior and habits and their link to the past and new delta conditions is therefore crucial¹⁵.

figure 04 — page 29



These four critical fronts require responses to enable the making of the delta of the future through the power of interdisciplinary designs that (1) help us to collectively address the complexities of climate transformation, (2) foster inclusiveness and deliberation, recognize competition for space and different values and desires, (3) activate interventions and promote leadership and confidence, (4) create cultural purpose and narrative on change towards a visionary approach and (5) create safe, healthy and high quality urban environments.

The complex challenges from the four critical fronts call to action on design-driven methods that are able to spatialise and make visible and tangible a cultural shift in the current research on climate. This envisions a new path, and breaking the dependence from old paradigms, promotes new ways of managing water and planning urbanisation trends, it builds a long-term policy perspective which embraces uncertainty, cross-boundary and cross-level cooperation as well as citizen input. To address these challenges through the agency of design, six research lines of inquiries are identified to lead the focus of the Delta Urbanism field. The lines of inquiry that contribute to unique perspectives, from systemic approaches to extreme conditions, synthesis of interdisciplinary research, and innovative strategies for living in delta conditions are extremes, deltaic systems, flow, delta culture, human earth, and urban earth.

DELTA URBANISM: SIX LINES OF INQUIRY

This paper questions how the research field of Delta Urbanism can provide a transformative ‘prospect for action’ to establish a critical but concrete pathway for a more resilient Delta future, where assertion and proof are synergized. To this end, the six lines of inquiry are further elaborated to deliver fundamental, experimental and strategic & operational outputs. These outputs comprehensively define the pathway for further research as a response to the four mentioned beforehand critical fronts.

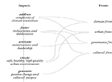
In this perspective, research is aimed at providing the Delta community with design as a tool for change, that is underpinned by scientific knowledge and methodological guidance to enable making a radical shift from incre-

14 Molenveld et al., 2020
15 Marks et al., 2022

mental change to transformational change also in culture and behaviour. The objective of delta research aspires to settle a new series of paths capable of crossing the boundaries defined in the critical fronts (policies, urban planning, spatial design, water management, and liveability of delta in general).

The outcome is expected to include a number of concrete changes in regulations and plans, for selected regions in which design acts as a tool for catalysing societal support and appraisal, in order to create new narratives and driving action in the face of climate change. The research as such would provide spatial projects at several scales (visions, strategies, master-plans, site-specific measures and principles), methods and design-thinking approaches in an integrated process of delta analysis and modelling, design and implementation. The lines of inquiry extremes, deltaic systems, flow, delta culture, human earth, and urban earth are developed on the basis of the epistemological knowledge that characterises the field of delta urbanism and the main challenges that the field is facing¹⁶.

figure 05 — page 30



Extremes

Extremes adopt a systemic approach to understand territories undergoing simultaneous dynamics of degeneration and regeneration. This line of inquiry delves into the intricate interplay of soil-water-atmosphere, exploring a continuum (from the micro-scale of individual sites to the macro-scale of entire ecosystems) to develop a holistic understanding of the territory. The project is grounded in the ethos of designing for, with, and in response to the changing socio-ecological landscapes, where degenerating aspects such as submerging, floating, eroding, and drying are juxtaposed with regenerating elements encompassing resources, social structures, economic systems, and environmental vitality¹⁷. The incorporation of extremes as a tool for scenario thinking, pushing the boundaries of the conventional design approach, questions the very paradigm under extreme conditions. This endeavor prompts a critical examination of safety considerations and serves as a catalyst for paradigm testing within the discipline. The multidimensional exploration of extremes and complexity inherent in the project not only contributes to a nuanced understanding of territories but also challenges preconceived notions, fostering innovation and resilience in the face of dynamic socio-ecological challenges. To illustrate, consider a coastal region where the interplay of erosion and reclamation projects vividly demonstrates these concepts. This not only enriches our understanding of these territories but also brings a human element into focus, considering how such environmental transformations impact local communities and their way of living. In essence, this line of inquiry is a journey through the vivid landscapes of change, where every challenge is a window to innovation and every extreme condition a testament to human resilience and adaptability.

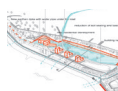
figure 06 — page 30



Deltaic Systems

Deltaic Systems is the line of inquiry of Delta Urbanism that moves the notion of the delta to the one of a deltaic to cross the boundaries between the delta-related specialisms. Traditionally, the geoscience field has dominated the understanding and subsequent management of deltaic areas around the globe. Today, the changes in sea levels, sedimentation processes, rainfall patterns, riverine discharge, polder constructions, groundwater tables, and urbanization are all intertwined layers that depict the growing complexity of the land-water dynamism. These need to be aligned when doing research and design to envision climate adaptation strategies and measures for the urbanized deltas. Climate projections, numerical modelling tools, and the thriving trends in outlining the social implications of climate changes in deltaic areas are all fundamental in detailing the problems of current and future times. How this extensive body of quantitative and qualitative knowledge defines the boundary of the delta and informs its (re)design is still a matter. Deltaic Systems aims to synthesize the long-term intertwining between disciplines to support a common interpretation of the delta and foresee future perspectives for climate adaptation designs¹⁸. This approach tackles deltas as complex systems where interdisciplinary research is at the core and where each discipline, from hydraulic engineering to spatial design, from applied mathematics to social engagement, equally contributes to the delta discourse. It also aims at materializing a collaborative set of theoretical and operational frameworks for experimentation, research, and design.

figure 07 — page 31



Flow

Flow is the branch of Delta Urbanism that challenges the static notion of architecture and urbanism and explores non-static approaches of inhabiting space within the delta condition. It investigates how we can live differently in water and land dynamics¹⁹. Flow involves research and design in a new, floating condition, as a means of long-term adaptation, synergized with the dynamic environment of the delta. It focuses on flexible strategies and planning for change aiming at providing tangible solutions to climate challenges through large-scale flexible and adaptable projects in urban environments. In the context where the largest urban settlements are located at delta conditions, the notion of Flow becomes crucial to reconceptualize in theory and practice our ways of living with water.

figure 08 — page 31



Delta Culture

Refers to the impact of the territory on how people deal with it with their traditional vernaculars and arts. The 'cultural' aspect in the context of landscapes and deltas finds its roots in the rich tradition of Dutch landscape painting, emerging from the 16th century²⁰. During this period, artists began emphasizing expansive regional vistas in their works, diminishing the prominence of human figures within these scenes. The term “cultural landscape” is employed across geography, ecology, and heritage studies to describe the dynamic interplay between human activities and the environment²¹.

- 18 Bai et al., 2016; Welch et al., 2017
- 19 Aiken et al., 2014
- 20 Klaver, 2012
- 21 Jones, 2003

Defined by the World Heritage Committee, it encompasses “cultural properties that represent the combined contributions of nature and humanity”²².

22 UNESCO World Heritage Centre, 2011
23 Gunderson, 2010

In response to growing environmental consciousness and ecological concerns, a different perspective on landscapes emerges, closely tied to the concepts of nature and the environment. Environmental threats and the rapid transformation of landscapes due to global economic forces have underscored the importance of preserving and managing areas with historical or natural significance. In the context of globalization and the challenges posed by climate change, including industrialization, urbanization, and transportation, this broader notion of the Cultural Delta gains relevance.

figure 09 — page 32



Human Earth

The first strand relates to political ecology and the role of governance in the climate transformative approach. Realising the age-old interaction between the earth and the human species within the broader natural ecosystem, our work in this line of inquiry is premised on the idea that risk and crises/disasters can be triggered by humans’ interference with the natural ecosystem²³. This is notwithstanding the fact that some disasters can be purely natural. On the other hand, different perceptions and interpretations of crises/disasters and the processes that bring them about exist among people depending on their backgrounds and experiences. These perceptions and interpretations inform the adaptation approaches and how they are governed. This can relate to whether they are disciplinary, top-down, and myopic or interdisciplinary, network-based, and comprehensive. In turn, the adaptation approaches and how they are governed determine the levels of resilience that can be built. Thus questions should be addressed on the consequences of our actions on the natural environment with regard to risk and disasters, our interpretations and perceptions, the approaches we use to tackle the risk and respond to disasters, how we organise ourselves, and the effectiveness of our efforts within that prism. Another strand relates to the distribution of environmental benefits and burdens (social environmental justice). Currently, there is an unequal distribution amongst the population regarding the ones who have access to such benefits and the ones who face the largest impact from disasters/crises. Questions need therefore to be addressed about how best to appropriate such benefits and burdens in a fair manner, where claims of injustice exist, how best to listen to citizens’ voices, and how well to consider silent/invisible actors in solving the problems.

figure 10 — page 32

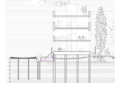


Urban Earth

Urban Earth focuses on the de-reconstruction of nature for human and non human habitation, with the overarching goal of rejuvenating urban tissues and fostering overall urban health. At its core, the approach involves a process of reverse engineering with nature, seeking to understand and replicate natural systems to enhance the vitality of urban spaces. This is achieved by unlearning the purely technical approach of urbanizing Earth to tune technological interventions with the aim of giving the ecological

systems more space and impact. The research extends its focus beyond theoretical realms, engaging with real-world challenges and opportunities. By integrating these crucial elements, Urban Earth not only addresses the immediate concerns of urban development but also strives to create sustainable, resilient, and healthy urban environments. The emphasis on de-reconstruction underscores a departure from conventional urban planning paradigms, signaling a paradigm shift towards holistic and nature-inspired approaches for the betterment of urban life. The role of soil, for example, gained enormous attention today as an urgent issue in keeping the earth healthy. Healthy soils should be recognized for their quality, quantity, and performance for healthy urban life. This line of inquiry focuses on the urban scale and its interdisciplinary character.

figure 11 — page 33



FUNDAMENTAL, EXPERIMENTAL, AND STRATEGIC AND OPERATIONAL OUTPUTS

Starting from the four critical fronts for which ‘prospects of action’ are needed, the six lines of inquiry of Delta Urbanism research were defined under the shared expertise and perspective within a research by design driven approach. The output of these lines of inquiry aims to contribute to fundamental, experimental, strategic and operational implementation. Fundamental concerns theoretical advancement in the field of Urbanism and scientific development through new insights in the academic research community and in the educational environment as well²⁴. Experimental concerns tests and experiments that would contribute to innovative systemic change. Creating scenarios for an alternative future of the delta(s) as well as experimenting and testing novel ideas in the real world are part of this experimental approach. Lastly, the research output that concerns the strategic and operational output mainly consists of the creation of (spatial) strategies and tactics for the deltas as well as tools for practice towards delta resilience²⁵.

Fundamental outputs

The creation of new insight that adds to the previous body of knowledge is crucial to understand systems changes, set the direction for (new) transition pathways and generate transformative change. The broad and rapid transformations in energy transition, housing, migration, and technology require quick reactions and fast adaptation scenarios especially in order to cope with conditions of climate extremes. At the same time, as much as it is crucial to adapt and respond to the critical challenges of our times, it is necessary to work on fundamental knowledge about long-term systemic changes. Fundamental research can explore approaches that are more connected to structural changes based on the six lines of inquiry, critically addressing and revisiting questions such as climate adaptation, living with nature, socio-environmental justice, conditions of extremes, and systemic and cultural landscape approaches.

The fundamental output can be broadly divided into three main categories. The first involves building up knowledge through a scientific perspective on (critical) theory, systems thinking, and Delta Urbanism. It concerns in depth ontological research which builds up and/or even ques-

24 Nazarov, 2019
25 Seijger et al., 2019

tions existing scientific knowledge regarding climate, urbanism, ecology, history and culture, and the underlying methods and theories. New adaptation pathways and hypotheses for addressing future climate challenges might emerge. For example, a general scientific recognition originated in the past decades that we are living in an era where technological solutions are not able to solely fix climate challenges. In that line, diving deep into history (*longue durée*) can provide another angle through which to approach the question of adaptation and living closer to natural, organic dynamics. Instead of arguing that we have mastered the forces of nature, learning from the past and interweaving traditional practices (eg. circular water stories, traditional water systems) with current ones opens new, resilient, and timeless perspectives to adaptation.

The second involves the role of design as a tool for inquiry and creating new narratives. Design and its capacity to create imaginaries and alternative visions to question the current reality can be a powerful tool to trigger narratives that are reflective and transformative and stimulate change. Design as an analytic instrument for creation can forge new scenarios and help address the gap between what was at one time the natural state of the delta and the current controlled highly-engineered one that has been developed over time, including climate pressures (sea level rise, river flooding, salinization, erosion).

Lastly, the third focuses on transformative change through and within education. It reflects on the changes needed in educational institutions and pedagogical practices to stimulate and facilitate explorations that are informed by and inform the first two categories on theory-building and design inquiries. Fundamental outputs need to be built up across both, in-depth disciplinary as well as inter- and transdisciplinary research and education activity. This means going beyond traditionally collaborating disciplines. To generate transformative change, conceive new narratives, and raise forward-thinking questions, theoretical frameworks between solution-driven engineering, arts, science, and technology are needed. Compared to experimental and strategic & operational, fundamental outputs require more time, yet the impact is crucial in rethinking and redesigning the future of deltaic areas.

figure 12 — page 34



Experimental outputs

At an experimental level, the output focuses on the exploration of the new pathways set as part of the fundamental knowledge as well as to test societal responses based on these narratives. These experiments involve a wide range of approaches, from design explorations to hands-on experiments. On one hand, this concerns the creation of scale models and tests in laboratories that explore future scenarios or real-time simulations. Also, setting up pilot projects to test 1:1 designs (climate adaptation scenarios, new materials) on site. On the other hand, experimental outputs can also operate at a speculative level, testing radical visions and ideas and involve a broad scope of experts involved²⁶. The room for exploration that this approach allows, makes it possible to test long term visions and open a dialogue on radical future transformations.

Moreover, due to the unpredictability of human behaviour and responses to future delta conditions, experimental research can provide valuable support in testing how humans respond to these emerging realities. It gives insight into how culture can be used as a tool for connecting agendas and actors, and also awareness-building. This is a pressing issue in dealing with climate adaptation, as there is a lack of knowledge on how to trigger behavioral change over a long time span. Because of uncertainty in climate predictions coupled with other immediate human needs, many players do not see the urgency of investing in climate transition on a long term basis or taking risks for the greater good. While this is the case, scientific evidence for societal processes that govern major transitions is scarce. A question arises whether research on risk perception and behavior can proffer design solutions that promote forward-lookingness and intergenerational justice. On the flip side, questions relating to the role of design in behavioural change still need answers and experimental research and design can offer valuable insights into this direction. This is strongly connected to the cultural societal perspective that responds to the fact that the uncertainty of predictions and the problems it presents in convincing certain sections of society, needs a narrative.

The experimental research goes hand in hand with methodology development to accelerate interdisciplinary and transdisciplinary knowledge production and apply monitoring methods for knowledge integration in consortia. One urgent methodological output, that comes from a design-driven approach, is the development of a catalysts framework to create long-term policy perspectives, an integrated framework of process, design, and engineering-models related to delta analysis, design, and implementation. Another methodological experimentation is the exploration of projects that aim to create convergences between arts, science, and technology.. Such approaches of bridging arts and sciences became popular also within the European Union research line, with Horizon Europe projects such as Back to Earth, promoting collaborations between arts and sciences²⁷.

The lines of inquiry bring together the methodological approach connecting science and engineering to cultural and design questions and create shared values, together with shared understandings. Experimental outputs have the capacity to trigger change in governance, impact community perceptions, stimulate behavioral change, assess the feasibility of new pathways and break path dependency²⁸.

figure 13 — page 35



Strategic & operational outputs

Lastly, strategic and operational outputs have the capacity to disseminate knowledge beyond the academic realm because they offer ‘prospects of action’ with the focus on impact in practice. These outputs are created by building from the fundamental, experimental outputs towards tangible tactics. Strategic and operational outputs have found implementation in design projects (eg. Room for the River). The urgency of responses has also informed the creation of alliances between academic and non-academic institutions, private partners, and governmental organizations (such as Delta Alliance).

Strategic output should also take into consideration context-based approaches, adapting frameworks from fundamental and experimental

- 27 Back to Earth: bringing communities and citizens closer to soil, 2023
- 28 Schreiber et al., 2023

research into specific case studies and places. Broad transformations such as climate change, energy transition, housing, migration, and technology have spatial consequences for different delta contexts. This calls for big shifts in spatial planning and design approaches, but at the same time acknowledging differences in physical, economic, social, and cultural contexts. To effectively use the evidence, we need to understand the current path(s) which is/are also contextual depending on local conditions and policy orientation. Further, we need to understand how we can trigger change and break dependence. This calls for approaches and techniques that push transformational thinking²⁹. Design can be one such technique because of its power to stimulate imagination and visioning processes. However, there is a need to define what robust design for resilient deltas is, what it entails, and how it relates to other disciplines. In the same vein, we need to learn how we can relate better design to science and to society (awareness, narratives, inputs from citizens, etc)³⁰.

Governance rearrangements have been popularised as one panacea for speeding up climate adaptation. These processes have often been stifled by party politics that, owing to the dominance of ideological orientations and short-termism, have put something on the ground before their terms end. In some cases in the Netherlands, this is exacerbated in rigid top-down approaches that persevere with the paradigm of maintaining or even creating dry and safe land at any cost disregarding the risks related to subsidence and sea level rise. Further, the currently debated scenarios on protect/close, retreat, accommodate and/or advance are dependent on multiple site-specific factors (morphological, economical, financial, social, technological) that are not always considered. But the fact that the deltas are a complex land defined by different subsystems sometimes epitomises a multidimensional paradox that does not help much in spatial decision making³¹. This therefore requires understanding and modelling of the impact of climate change on spatial configurations, and of the potential impact of using spatial planning and design techniques in adaptation to the landscape, on humans, and on amphibious life³². The strategic & operational output aspire to fill the gap of knowledge on how to generate strategic impact, challenge the dominant narrative, and create governance transition.

figure 14 — page 35



CONCLUSIONS

The challenges that deltaic areas face demand a multidimensional and collaborative approach. The increasing complexity of socio-ecological issues in these regions, exacerbated by climate change and rapid urbanization, necessitates immediate and sustainable responses. Despite human influences on the Earth's system, uncertainties persist, especially in climate projections, hindering effective adaptation strategies. The disconnection between engineering practices and socio-spatial approaches further complicates efforts to address the intricate challenges of deltaic landscapes. Sustainable responses are lagging due to short-termism, blurred policy accountability, and an unwillingness among decision-makers to accommodate change and uncertainty. Transformation in governance and knowledge institutions is crucial to achieving intergenerational justice in climate adaptation. Cultural shifts are essential to garner support for societal change, breaking existing patterns, and fostering a shared understanding, vision, and strategy.

- 29 Wesselink et. al, 2022
- 30 Amirzadeh, Sobhaninia, and Sharifi, 2022
- 31 Palmboom, 2014
- 32 van Leeuwen et al., 2009

The four critical fronts —climate, urban, governance, and cultural— provide a framework for ‘prospects for action’ in addressing delta challenges. The Delta Urbanism research is set out in six lines of inquiry: extremes, deltaic systems, flow, delta culture, human earth, and urban earth, that contribute unique perspectives: from systemic approaches to extreme conditions, synthesis of interdisciplinary research, and innovative strategies for living in delta conditions. While the Delta community has made significant strides in addressing the complex challenges of deltaic areas, it is crucial to acknowledge that there are still important advancements to be made and gaps to be addressed in both research and practice. Beyond collaborations across disciplines and sectors that have taken place, moving forward requires a comprehensive reflection, elaboration, and expansion of the types of outputs.

When coming to fundamental knowledge, it is essential to challenge, update, and potentially replace existing theoretical and scientific frames within the realm of Delta Urbanism research. Additionally, there is a need to broaden the scientific perspective to encompass inter- and transdisciplinary knowledge creation, fostering transformative change through education. Radical visions and ideas can also be tested bridging fields like arts, science, and technology. This can be achieved by transforming experimentations into tangible outcomes and implementations of critical design projects.

With reference to The Netherlands, and indeed still applicable in many delta contexts, a question emerges about how, from a system perspective, considering the environmental and socio-economic challenges, we can capture the potential of the Dutch Delta in a visionary future where life, work and recreation can be safe, inclusive, and sustainable in a climate responsive territory. How to envision and support this with plausible arguments based on sound principles and situated design strategies is an ongoing question. As mentioned above, insights into system changes due to climate extremes, sea level rise, and impact on the a-biotic system can provide sign-posts for formulating sound transformational principles and strategies. Therefore, localised images of consequences (scenarios) of (non) intervention and credible transition directions are needed. Yet, these localised images have to be interpreted by the various actors (policymakers, designers, engineers, researchers, etc) not as static, fixed projects but as flexible scenarios subject to dialogue and change.

The six lines of inquiry are approached within the Delta Urbanism community mainly through the lenses of research by design-driven methods. Leveraging the visioning power of spatialization, research, and design in urbanism can convince key actors to change regulatory frameworks and trigger further experiments and interdisciplinary actions. This way, the Delta community is provided with a tool for change underpinned by scientific knowledge and methodological guidance. Research by design is a catalyst to build a framework of long-term design perspectives and integrate these into a framework of process, policy and engineering models related to delta analysis, modelling, design, and implementation. The transformative power of spatial design at multiple scales extended beyond academia can also become an agent of cultural and behavioral shift, generating new approaches to water management and urbanization in the Netherlands and abroad.

The outcomes of the six research lines, focusing on fundamental, experimental, and strategic and operational knowledge creation,

aim to contribute to theory development, systemic change, and the creation of spatial strategies for delta resilience. These outputs, transformed into actions, impact the four critical fronts addressing the complexities of climate transitions, fostering inclusiveness, and promoting long-term change. Achieving these desired impacts requires collaboration, integration, and a commitment to building bridges across disciplines and spatial territories, ultimately shaping the delta of the future.

Although many actors in climate adaptation are aware that it is integral to build bridges across hierarchies, disciplines, departments, and spatial territories, limitations remain and there is still a need for a clear understanding of underlying constraints. Understanding such constraints will help inform players to come up with winning spatial and institutional design strategies. But even with the understanding of the constraints at hand, the question of what it takes to make a new path still remains. There is a need for an integrated series of frameworks for flexible designs that are informed by techno-socio-ecological systems related to delta analysis. To generate such frameworks, constraints such as norms, values, laws, and policy processes need to be transformed by embracing new knowledge and taking advantage of strategic and symbolic capital such as scientific institutions.

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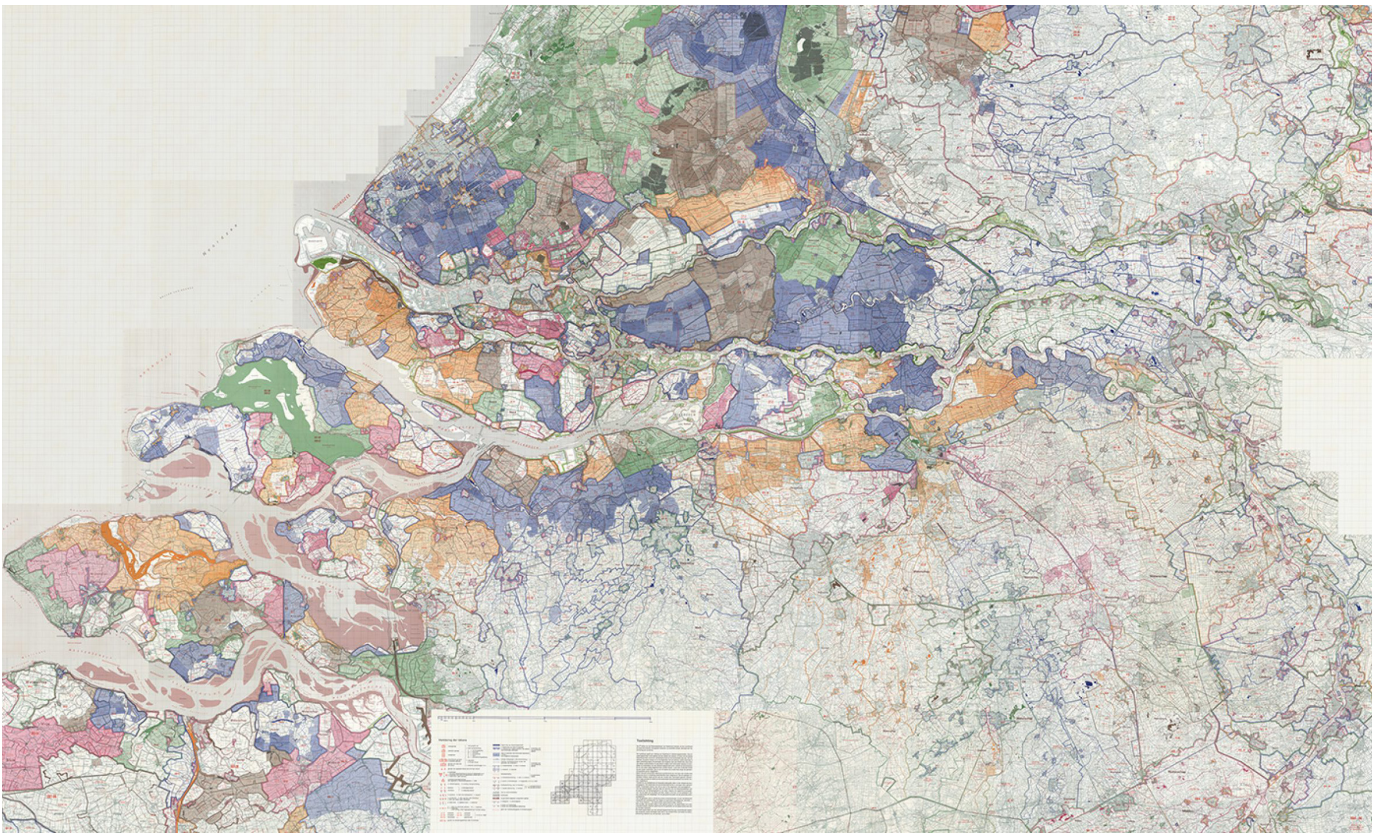
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01 The climate front in the changing environmental conditions of the Ganges-Brahmaputra Delta. Source: Yale 360/Planet Observer, 2024.

02 The urban front in the rapidly urbanized Pearl River Delta. Source: Nasa Earth Observatory, 2024.



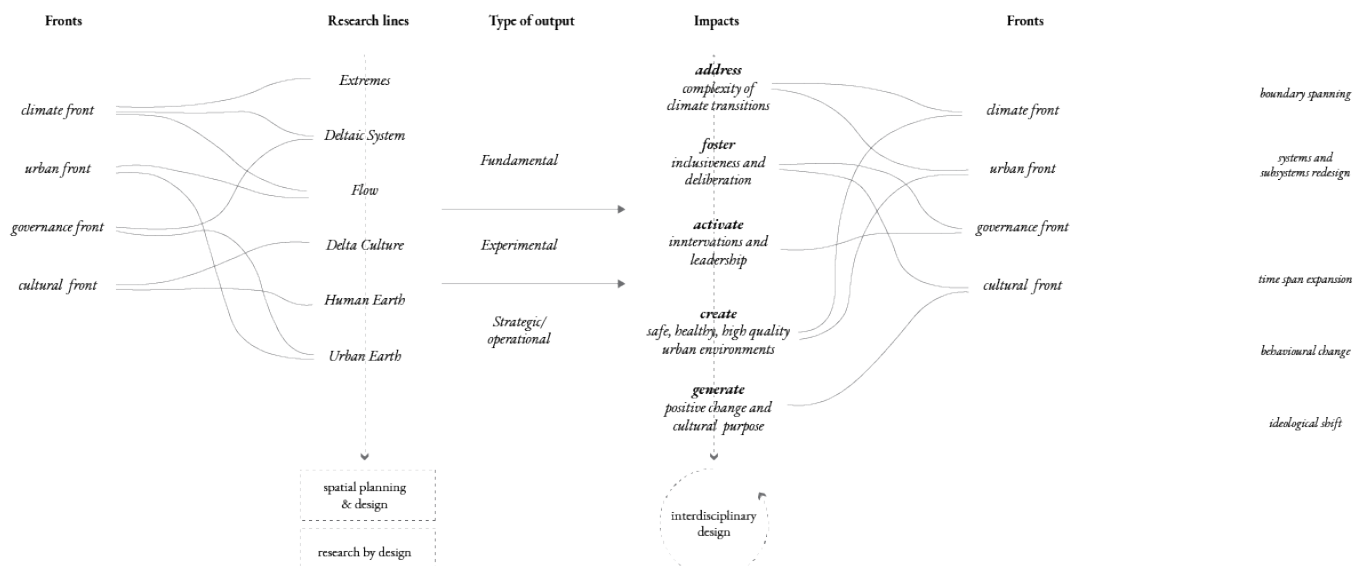
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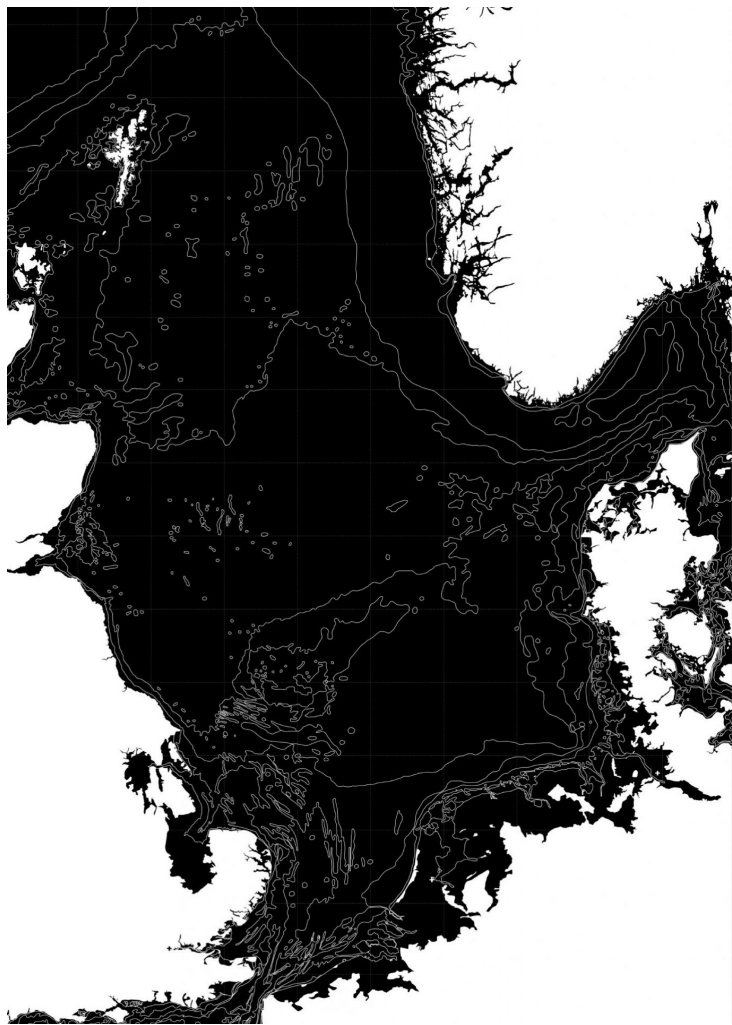
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03 The governance front, water management map of the Netherlands 1872 . Source: Delta Urbanism, 2024.

04 The cultural front: understanding human behavior and habits in the Dutch delta condition. Source: Luca Iuorio, Delfzijl, Groningen, 2021.



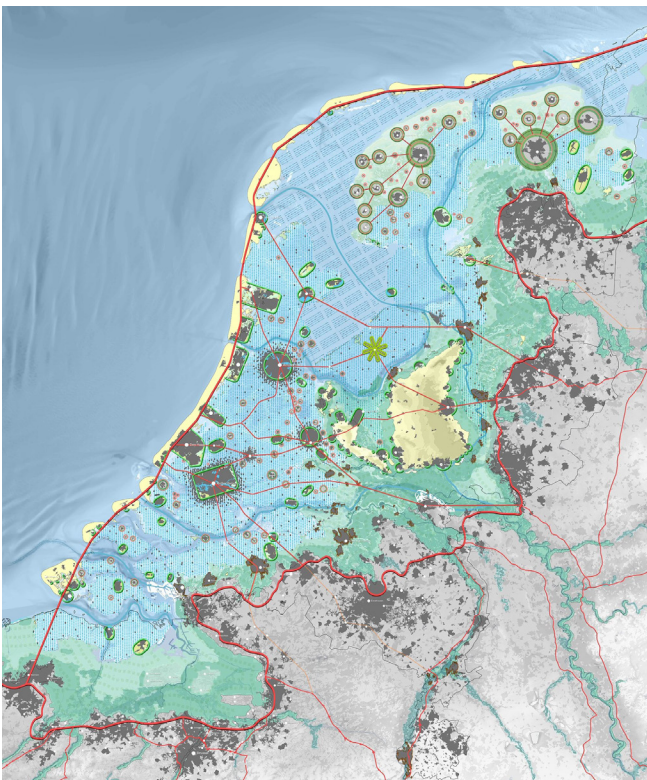
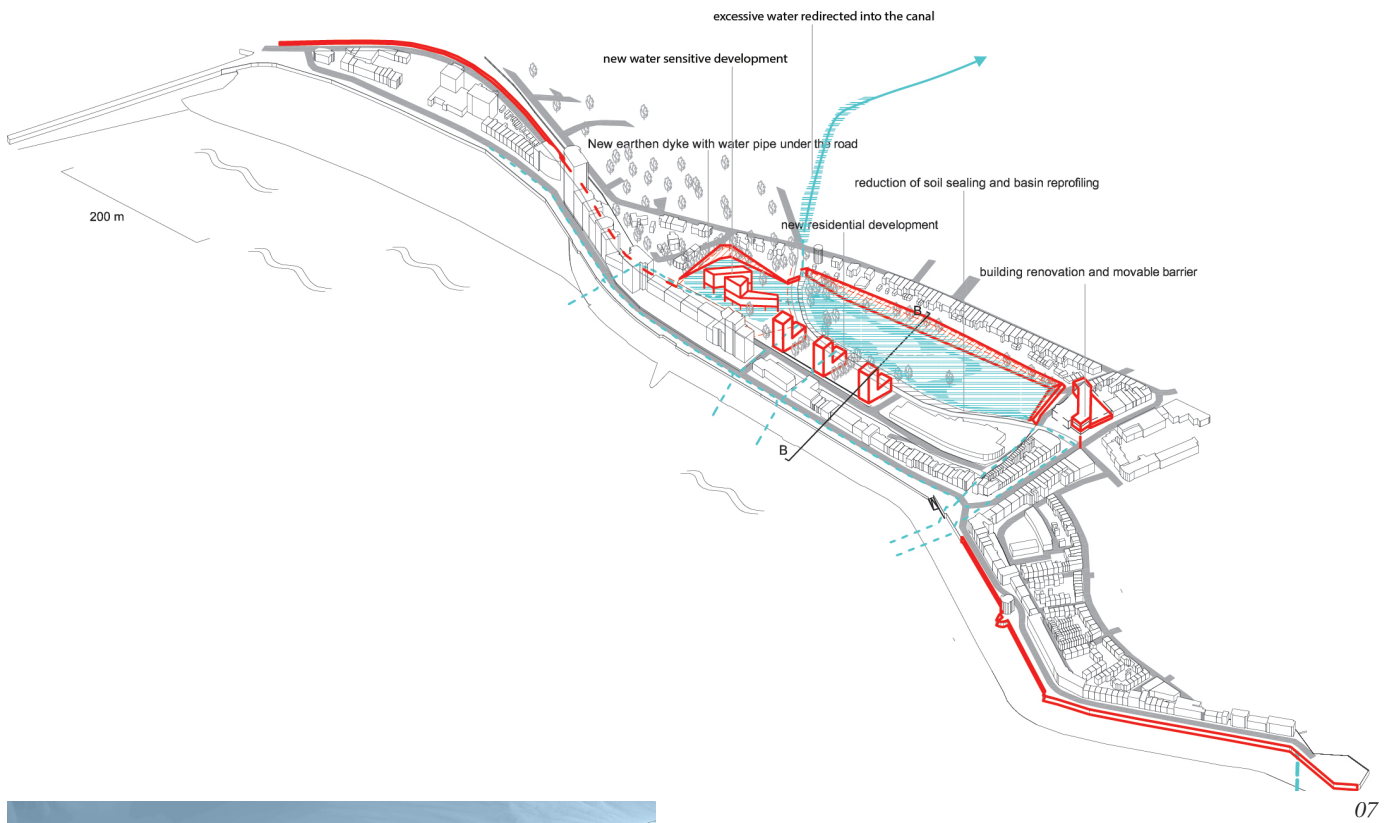
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05 Overview of how to go from problem fields to transformative change in the four critical fronts.

06 Territory as a Project—Extreme Ecologies, Infrastructure and Forms of Life. Source: Delta Urbanism Research group, 2017-2018.



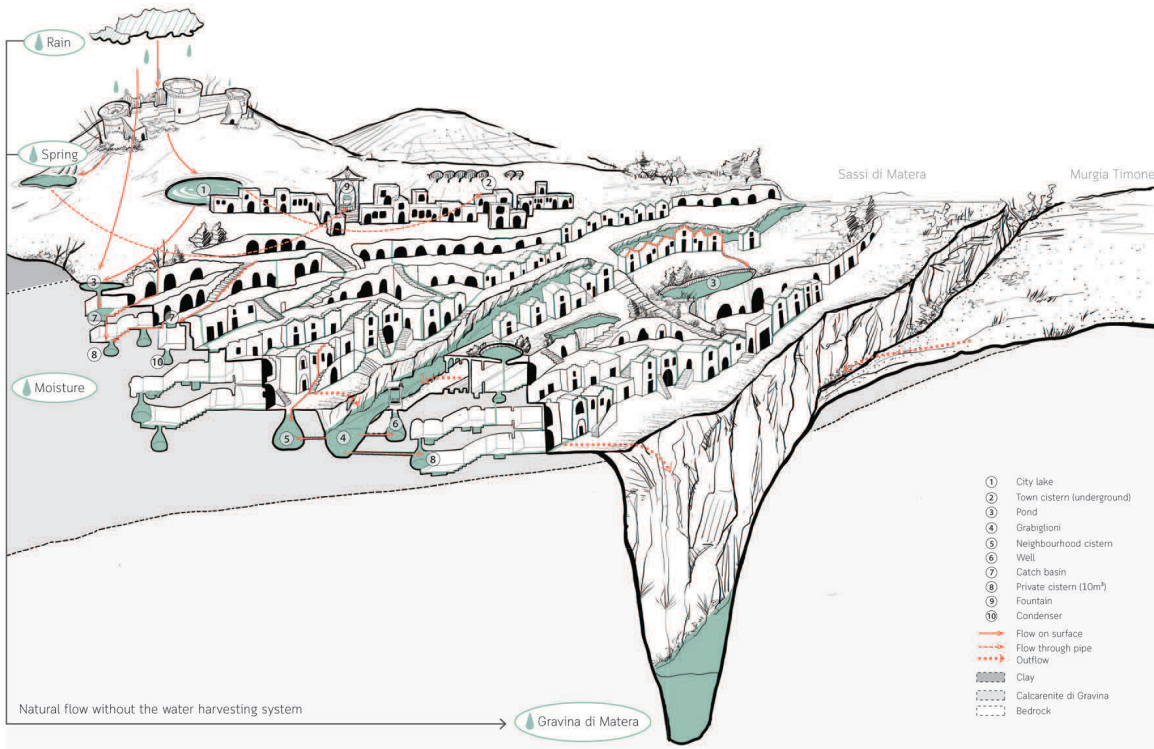
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07 Interdisciplinary research and design of deltas as complex systems. Source: Sustainable and Resilient Coastal Cities, Vlissingen, F. Hooimeijer, A. Bortolotti, L. Iuorio, 2022.

08 A vision for the future of the Netherlands based on a floating condition. Source: Plan B NL 2200, LOLA Landscape Architects, 2020.



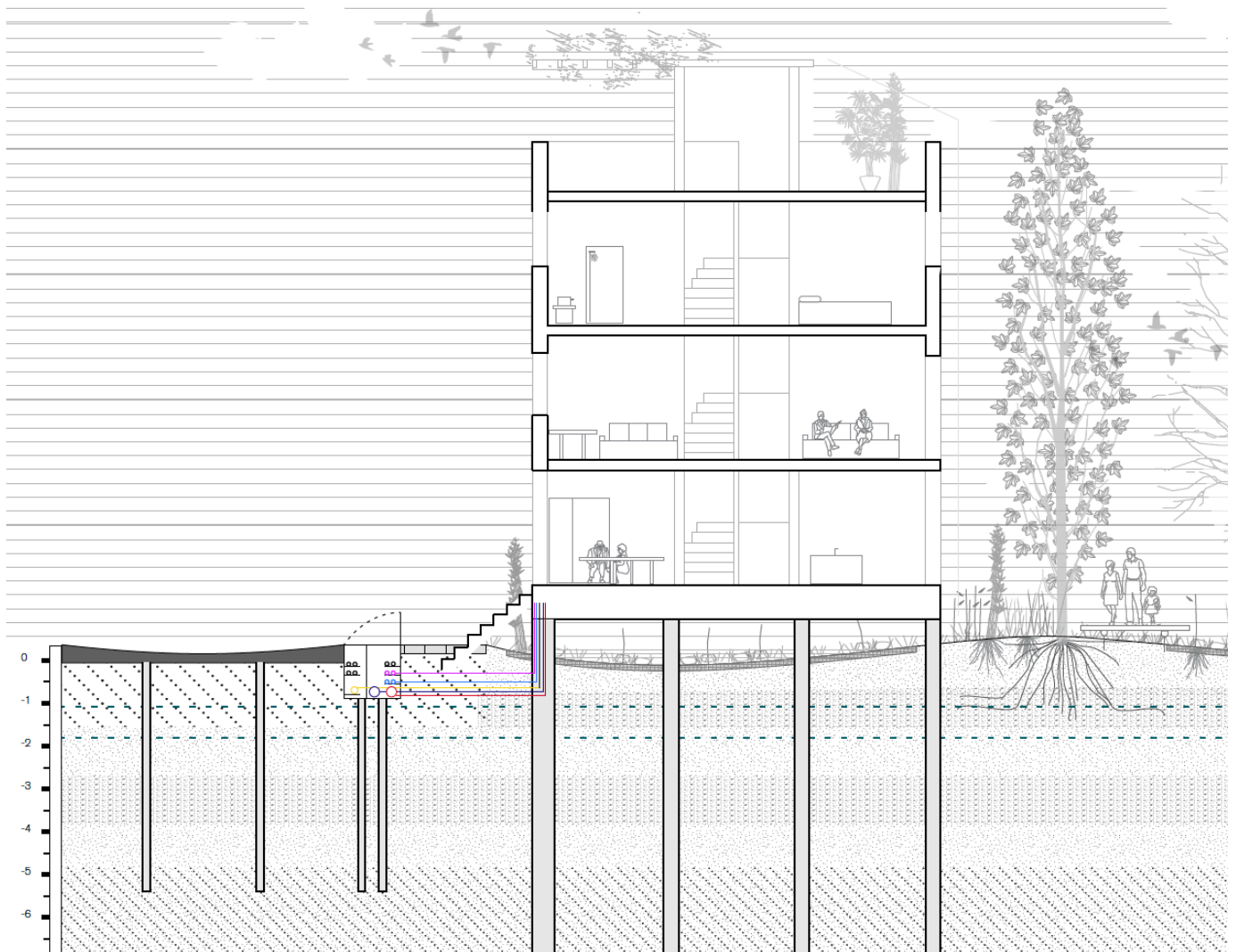
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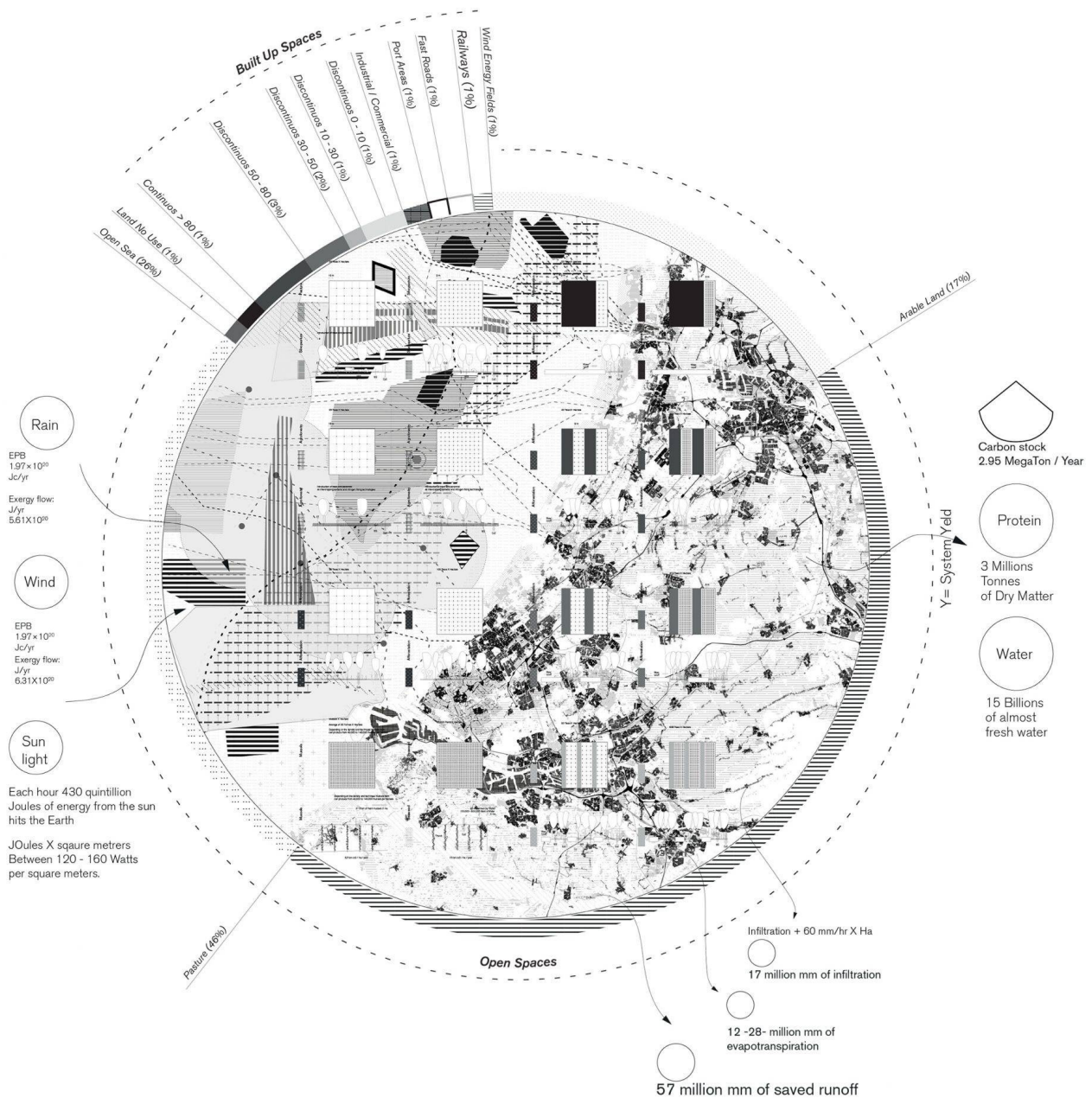
09 Traditional water harvesting system, Matera. Source: W. Gao, 2022 in I. Bobbink, W. Gao, I. Banfi, 2023.

10 Identification of areas for an integrative climate transformative approach. Source: Redesigning Deltas, 2022-2023.



11

- 11 Design of urban space and the subsurface through a process of reverse engineering with nature. Source: F. Hooimeijer, T. Kuznecow Bacchin, F. LaFleur, 2019.



12

12 Next extremes: Constructed natures, a reconceptualization of infrastructure and the environment to develop a new set of design principles. Source: F. LaFleur, T. Kuzniecowa Bacchin, F. Hooimeijer, 2019.



13



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13 Reporting space time and everyday life in the Delta, Experimental Research between Arts & Sciences. Source: Luca Iuorio et. al., Delta Urbanism Research group, 2023-2024.

14 Room for the River project. Source: Programme team room for the River, 2005

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