Blue-Green Critical Infrastructure beyond Contingency Planning and Risk Management: Towards integrated Regional Design Strategies for In-between Territories of the Greater Bay Area.

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Abstract

The demand for Blue-Green Infrastructure (BGI) planning has increased in the last 30 years in rapidly transforming China. An under-theorized question is how to define a BGI strategy at the Mega-City scale comprehensively. New approaches to regional planning that prioritise the well-being of people and the livability of settlements at the local scale are treated. Formulating future-proof design and planning strategies at the regional scale necessitates the inclusion of the In-between Territories binding together high-density and dispersed cities in metropolitan clusters. This paper aims to rethink a Blue-Green Infrastructure Design Framework for the Greater Bay Area (GBA) in Guangdong Province, China. The growing GBA in China is a challenging opportunity to envision sustainable environmental, social and economic futures at the local, regional and cross-border scale. While often overlooked, the In-between Territories engulfing the main 9+2 cities forming the GBA transactional network are crucial for the integration and longevity of the Great Bay Area vision. Inevitably, the GBA development strategy emphasizes economic and business integration, improved transport connectivity, technological knowledge transfer, synergistic capital, and environmental preservation of the GBA cities network. The 'Outline Development Plan' (ODP) from 2019 for the Guangdong-Hong Kong-Macao Greater Bay Area pledges to advance Ecological Conservation, to support socially just and Healthy Cities in the region. The proposed alternative design approach seeks to establish, re-integrate and protect In-between Territories as the Critical Blue-Green Infrastructure and the backbone resource of a world-class urban agglomeration. The GBA is comparable to the globally influential mega-urban regions comparable to the San Francisco Bay Area, Greater Tokyo Bay and the Rhine Delta. An environmental, health, or economic crisis in one interlinked city cluster ultimately leads to global systemic repercussions. Given the planetary interrelatedness, a comprehensive design approach of Critical Blue-Green Infrastructure protection and maintenance at the Mega-City scale is not merely a local and regional responsibility. Top-down city-network planning approaches alone are inadequate for advancing the sustainable transformation of local-scale human settlements. The challenges for city planning at a mega-city cluster scale are the better integration of Top-down planning strategies and the re-naturing of In-between Territories with emerging Bottom-up community initiatives and livelihood ecologies. Furthermore, to enhance Blue-Green urban infrastructures, new challenges are how to blend smart agricultural practices and digital economies in In-Between Territories. Better relationships between Top-down & Bottom-up and the synthesis of Digital and Natural ecologies may reinforce the Urban-Rural transformation to benefit people at the local scale. Moreover, the need for adaptation and resilience planning goes beyond preparing for an unexpected collapse of a mega-city cluster. Instead, a long-term design approach seeks to develop self-perpetuating people and nature-oriented landscapes, supporting Productive Ecologies and continuously evolving the Sustainable Development of In-between Territories at the local, regional and city-cluster scale.

Keywords Critical Blue-Green Infrastructure, Greater Bay Area, Sustainable Ecologies, Resilience.

01._Introduction:

For human settlements in territories, which undergo urban transformations and ongoing disruptions of eco-system services, the fragmentation of social cohesion and economic resilience, the revisiting of socio-ecological design approaches at the regional scale is a growing field of research. This paper outlines five design strategies for preparing critical blue-green infrastructures for a better urban metabolism aiming to balance the mega-urban region's environmental, social and economic objectives. In contrast to developing cities that exacerbate climate change, the environmental crisis, social fragmentation and economic short-termism, this study seeks to outline an urban transition apprehensive to new types of urbanities, a society pursuing modernity and the adaptation to climate change.

Strategizing planning approaches and design proposals for mega-urban regions is both a daunting and invigorating endeavour allowing planning and design professionals to contribute to the evolution of human settlements positively. One of the difficulties is the many specialist disciplines and design parameters to consider, which can be overwhelming for conceptualising regional scale projects. Nevertheless, given the global interrelatedness of regions and mutual dependencies, it is increasingly unthinkable not to problematize and engage with mega-city scale projects. Hence, defining and discerning the critical parameters for design and envisioning an urban planning project can be supported by formulating the principles for new territorial rationalisations. This study aims to generate insights and transferable knowledge that could evolve for future research in different parts of the world. In this instance, the research concentrates on the Greater Bay Area in Guangdong Province, China.

02._Contextualization:

The Greater Bay Area (GBA) is an approx. 56000 km² mega-urban region located in South China. Consisting of eleven cities Guangzhou, Hong Kong, Shenzhen, Macau, Zhuhai, Foshan, Dongguan, Zhongshan, Jiangmen, Huizhou, and Zhaoqing, the GBA extends from the Pearl River Delta in the South coastal region of China (21°32'0"-24°26'0"N, 111°20'0"-115°24'0"E) to the mountainous Zhaoqing prefecture, bordering Guangxi and Hunan province. The GBA is home to over 86 million people (BayArea, 2020) and could reach a population of 100 million by 2035 (Lin, 2021). With a GDP of over USD 1,6 trillion in 2020 (BayArea, 2020), which accounts to approx.12 % of China's GDP (Cheung, 2019). In comparison, the Tokyo Greater Metropolitan Area has a coverage of approx. 14 000 km², a population of over 44 million and a GDP of over USD 1,7 trillion in 2020 (HKGCC, 2021).

The origin of the GBA vision can be traced in the 'Framework Agreement on Deepening Guangdong-Hong Kong-Macao Cooperation in the Development of the Greater Bay Area' by the National Development and Reform Commission and the governments of Guangdong, Hong Kong and Macao, in 2017. Its purpose was to lay the foundations for regional cross-border collaborations to advance innovation and development. Officially promulgated in 2019, the Greater Bay Area Outline development plan sets out the strategic collaboration between the eleven main cities of the GBA to enhance synergies in policy areas such as Innovation & Technology, Transportation & Logistics, Economic Development, Tourism, Education, Healthcare, Environmental protection and Sustainable development (BayArea, 2021).

The synergies between the eleven cities of the GBA with specialisation in the finance industry, manufacturing, pharmaceuticals, innovation, technology, R&D and tourism continue to evolve, targeting

coordinated regional economic development by 2035. The further development of the high-speed train network and bridge infrastructure projects have been implemented in terms of transport connectivity. In 2018, both the Guangzhou Shenzhen-Hong Kong Express Rail Link and Hong Kong-Zhuhai-Macau Bridge were opened.

The Greater Bay Area Outline development plan pledges to support green development and environmental protection. The emphasis of this research is to unfold the necessary advancements of environmental, sustainable development and design strategies for further transitioning to socio-environmental approaches of regional growth. In creating new insights and knowledge, the long-term aspiration is to rethink the current development pattern, which overemphasises economic growth, development of the real-estate sector and urbanisation predominantly in densely populated urban centres.

02.1._Policy background relevant to this study:

Since the 2000s, the National Congress of the Chinese Communist Party gradually began to pay attention to the disparities between urban and rural development. As a result, by 2006, China's National People's Congress pronounced the policy objective to "Construct a New Socialist Countryside" (Ahlers and Schubert, 2009). Its key mission was to address rural poverty, agricultural modernisation, consolidation and specialisation of farming operations, the investment in rural infrastructure, improved social welfare services in rural settlements, the development of cultural & countryside tourism, and overcoming the segregation of urban and rural planning. Further, in 2007 the Seventeenth National Congress of the Chinese Communist Party began to promote urban-rural integration to achieve a moderately prosperous society (Jinping, 2017).

Equally influential in this context is China's first official urbanization plan, the National New-Type Urbanization Plan 2014-2020 (NTUP). It is estimated that within the next 15 years, about one billion Chinese, making up more than 70 per cent of the population, will be urban residents. Therefore, in March 2014, the Central Committee of the CPC and the State Council released an urbanisation plan that focuses on an environmentally friendly and human-centred path. The urbanisation plan involves, People-oriented development of cities and towns, Urban-Rural integration and balanced development of society, reforms to the Hukou system, further growth of Mega-city clusters, the East-West & North-South urbanization corridors, considering the development of landlocked regions, reduction of industrial overcapacity building, coordination of infrastructure planning, environmental sustainability, ecological conservation, protection of natural resources, preservation of farmland, food independence, development of poverty-stricken regions, and the preservation of ethnic autonomous cultures. The goals of the NTUP continue to guide China's urban-rural integration in the 13th Five-year plan (FYP) (2016-2020); and the 14th FYP (2021-2025); (Fang, Ma, and Wang, 2015).

Due to the growing concern over environmental degradation, by the Guangdong provincial government level, a proposal for a PRD Greenways Planning Strategy was prepared by the Party Secretary in 2009. Subsequently, in 2010, the Pearl River Delta Greenway Project (PRDGP) was launched as a three-year campaign by the Guangdong Province government. The Greenway movement initiative aims for better urban-rural integration, environmental preservation, as a regional scale planning strategy. Greenway projects have grown since 2012, and by 2019 over 8909 km of greenways have been created. Since its launch, the PRD Greenway Network planning strategy was adopted by other provincial governments.

Between 2010 and 2018, the initiative has generated approx. 56,000 km of greenways in China (Liu, Lin, De Meulder and Wang, 2019).

While the GBA Greenway Movement has grown into a paradigm for other provincial governments in China, the Greenway projects overlap with transport infrastructure developments and concentrate on open space networks in urban areas. Limited attention is paid to hybrid urban-rural areas, the remediation of industrial sites and territories outside the Mega-city urbanisation corridors, and a socio-environmental approach to sustainable development. Both ongoing top-down policy attention and support for ecological remediation at the local level and community participation as the next urbanization phase may create synergies between top-down and bottom-up Blue-Green Infrastructure Initiatives.

03._Research objectives for future urbanization phases:

a)_Long-term oriented design approaches seeking to develop self-perpetuating people and nature-based planning, supporting Productive Ecologies and continuously evolving the Sustainable Development of In-between Territories at the local, regional and city-cluster scale.

b)_The need for adaptation and resilience planning for In-between territories goes beyond preparing for an unexpected collapse of a mega-city cluster.

c)_To propose an alternative design framework which seeks to establish and protect In-between Territories as the Critical Blue-Green Infrastructure and the backbone resource of a world-class urban agglomeration.

d)_To enhance Blue-Green urban infrastructure, the crucial innovations are how to blend smart agricultural practices and digital economies in In-Between Territories.

e)_The challenges for city planning at a mega-city cluster scale are the better integration of Top-down planning strategies and methods for In-between Territories with emerging bottom-up community initiatives and diversified livelihood ecologies.

f)_Better relationships between Top-down & Bottom-up and the synthesis of Digital and Natural ecologies may reinforce the Urban-Rural transformation to benefit people at the local scale.

03.1._Epistemological Traditions & Theory:

Three schools of thought underpin this paper. Firstly, the concept of 'Géographie Volontaire' originated in France in the 1940s, which in essence argues for the application of Design Thinking to larger-scale spatial configurations. In France, 'L'Organisation de l'espace: Eléments de géographie volontaire' was published by Jean Labasse in 1966. The concept of 'la géographie volontaire' was pursued as a comprehensive approach for managing territories by architects, geographers and urbanists motivated by the need for national and regional reconstruction projects after WWII (Cupers, 2016). Similarly, in Italy, architect Vittorio Gregotti called for expanding the design scope of architecture to include large-scale territories in his book *Il territorio dell'architettura* from 1966. Given the current Global Challenges, including climate

change, food insecurity, poverty and environmental crisis, research projects in larger-scale territories are recognised as a growing field of expertise. Secondly, the Extended Metropolitan Region (EMR) concept in the Asian context was coined with the term 'Desakota' by Canadian Geographer Terry McGee in 1990. The term comes from two Indonesian words, Desa, which means village and Kota, the city. The term is used in urban geography to denote spatial zones or areas in the peri-urban regions of large cities. Its vital features include an intense co-existence and intensive intermingling between agricultural and urban land use and settlement (McGee, 2008).

McGee assesses the unique features of the transformation of rural-urban territories in East Asia in the past three decades. The emphasis is on the strategies of development that Asian governments employ. Most rural-urban changes in the region disregard the ongoing commitment to alleviating rural poverty, focusing on food security and rural development. The emphasis by the East Asian governments tends to be on the role of urbanisation as the major process that leads to the growth of the economy. The focus is justified by economic theories, for instance, that the economies of scale, creating and strengthening markets in cities and the increased productivity in a metropolis are crucial aspects or factors that lead to development.

Nonetheless, McGee (2008) argues that this approach is ineffective as it forms a false dichotomy or differentiation between urban and rural areas. Besides, McGee (2008) informs that the approach ignores the significant role of development to increase connections between rural and urban regions to fully transform society instead of separating the transitions in the two regions, i.e., rural and urban.

In particular, McGee (2008) argues for the replacement of superseded divisions between rural and urban areas, and moreover, recommends that integration or links between rural and urban endeavour a deliberate adoption of sustainable management strategies. The strategies used in developing rural regions should utilise concepts of eco-systems that link activities in urban and rural territories. In doing so, there will be the preservation of eco-systems that integrate extended metropolitan region (EMR). McGee (2008) argues that successful urbanisation of rural areas should ensure industry, agriculture, and other urban endeavours co-exist in a mixed-use landscape, provide the most effective option for preserving eco-systems within the EMR and simultaneously, create sustainable and liveable urban areas. In this way, policies should focus on making cities greener through reducing carbon footprints, promoting clean water and air, increasing green space and public parks and promoting user-friendly systems of public transport (McGee, 2010). Other endeavours include developing settlements that allow for cycling, walking paths and encouraging food production at the local community level.

Thirdly, the equally influential Garden City Movement, defined by English urban planner Ebenezer Howard in 1898, continues to be relevant not only in Western planning theory, but also in Asia. Some of the critical planning principles and ideas on social justice from Ebenezer Howard's publication "Tomorrow: A Peaceful Path to Real Reform", written in 1898, continue to inspire contemporary planning practices. The Garden City movement was introduced to China in the early twentieth century. As a worldwide movement, it has recently seen a rival, partly due to China's efforts for urban-rural integration and ecological restoration efforts in metropolitan areas.

Chinese cities, such as Chengdu are targeting to transform into a mega garden city by 2050. Shanghai was officially honoured as a 'National Garden City' by the Ministry of Construction for environmental improvements in 2004, for its ambitious plans to increase greenery coverage to 36 percent (Yamamoto, 2009). Similarly, several provincial governments continue to expand greenway networks to counter the

loss of vegetation coverage in cities. As a government-led top-down planning approach, the concept of the Garden City is adapted to mega-city scales in China.

In essence, the Garden City Movement promotes combining the benefits of town and countryside communities. Its principles, which are also applicable in the Chinese context, are the provision of generous green spaces, including a surrounding green belt of countryside to prevent unplanned sprawl, well connected and biodiversity-rich public parks, high-quality gardens, tree-lined streets and open spaces (Garden City Institute, 2021). Furthermore, considering the loss of agricultural land to urban construction in China, opportunities for communities to grow their food, including planning for farming in urban areas, remain a priority. Moreover, affordable housing with gardens in healthy communities, local employment opportunities, business activities, cultural and recreational amenities within walking distance and access to public transport systems are an essential mix of urban elements in the Garden Cities.

The three underlying theories, the French *Géographie Volontaire*, the Extended Metropolitan Region, which rejects a binary segregation into urban and rural territories, and recent variants of the Garden City movement in Asia, inform this paper. Adapted to new urban questions, the concepts may evolve into rethinking established epistemologies and research agendas. The primary concepts that synthesise the underlying three theories presented are the concept of design thinking applied to regional-scale planning projects and the idea of an environmentally friendly and people-oriented development approach.

03.2. _Mega-city Region and Territories:

The following section describes regional design. The description is essential as it helps to attain an overview of the spaces and scales for designers working on regional projects and how it assists in portraying the relevance of nature-based approaches for restoring eco-system functions in territories and designing a viable urban transition.

Before elaborating on the idea of regional design, it is necessary to define the term region. Defining regions to suit the purpose of urbanism requires consideration of the object of planning. Sustainable communities are the fundamental objects of planning, but it is also essential to look at the settlement structures, as communities are found within larger-scale spatial configurations.

The specific topography and climate of a region, for instance, significantly influence the evolution of settlements and morphology (Neuman, 2000). From the perspective of land use planning, a region is an inter-connected territory that its residents relate to through their economic transactions and activities. A region can also be described as an area where individuals live and execute the most recurring activities, or in other words, pursue their daily lives.

According to Neuman (2000), the regional design is an approach to embrace growth through the provision of a physical framework that helps in guiding or determining the best use of land in terms of shared benefits, the scale, and resources, as well as understanding how communities interrelate within a particular physical region. Regional design as a strategic design discipline is unique or different from that of urban and regional planning, but both disciplines have an impact on the morphology and transactional networks (Mc Gee, 2008) in a territory. Neuman and Zonneveld (2018) assert that regional design guides human settlements in a particular area by defining specialised functions, size, location, and how settlements interrelate. In addition, regional design directs the flow of human endeavours concerning

settlements through the existing linkages in infrastructure. The ultimate goal is to integrate infrastructure networks and settlements with eco-system services, hence attaining sustainability (Neuman and Zonneveld, 2018).

Further, the material-tactile design approaches of territorial planning (Viganò, Fabian and Secchi, 2016), both in theory and practice, is increasingly re-emerging as design problems in contemporary urbanism. In another article, Neuman and Zonneveld (2018) give two main reasons for the resurgence of regional design. First, from a structuralism point of view, it can be argued that regional design has been a longstanding basis for spatial planning, and it has re-emerged as it is a tool for spatial strategy, and it also serves in spatial management. Neuman (2000) also notes that the rebirth is a result of neo-traditional community planning and modern-day urbanism, two concepts that started as enterprises that initially utilised small scales, i.e., neighbourhoods and small communities. However, with the evolving knowledge in urban planning and design, the scale has grown to incorporate large cities part of mega-city regions. Therefore, the essence of regional design can best be understood by considering the emergence of new settlement structures with a regional perspective and acknowledging the global external factors or forces that drive urban growth. One such indicator of the forces and context, for instance, is the rise and growth of metropolitan economies as influential nodes in a service-based global economy.

The need to adapt to the new realities in the evolving world emphasises the essence of regional design. The new realities include high-tech digital innovation in telecommunications, the internet, and information systems that enable exchanges of capital and resources with metropolitan economies, which ultimately network a particular region. In addition, there is increased mobility, i.e., national and international migration, tourism, international business, and intra-regional mobility, which include increased emergence of plural modes of mobility, such as autonomous driverless cars and drone transportation, for example.

New conditions such as an increase in urban population, climate change, globalisation and their associated impacts, 'smart city' concepts and nature-based planning, drive urbanisation. With the new conditions of urbanisation, the need to form and apply spatial strategy at supra-metropolitan levels or scales cannot be overlooked (Neuman and Zonneveld 2018). The new forces that drive urbanisation in the contemporary and future world represent a new scale of dispersed urbanity, especially in the city region. Neuman and Zonneveld (2018) assert that the forces of urbanisation are associated with significant impacts that need to be addressed or dealt with by urbanism at a large scale that matches an ample urban-to-rural space, including the territories in-between. Regional design represents the strategic solutions to the macro-scale design problems in urbanism.

Regional design is pertinent in shaping the physical form of regions, considering it embraces a regional viewpoint that guides how human settlements & the environment, particularly in diffused cities (Indovina and Matassoni, 1990), are arranged. Moreover, regional design connects the communities through communication, transport, the sharing of natural resources, and other ways that cause urban-rural networks to emerge. Similarly, regional design helps keep the communities' territory sparsely populated by a better-coordinated use of resources and by avoiding an over-emphasis of high-density urban developments. Neuman (2000) proposes three objects of regional design, namely communities, the connections among them, and their environment.

Another critical aspect when assessing regional design pertains to understanding the contemporary design problems in urbanism. According to Neuman (2000), some of the sources of current regional

design thinking are the existing critique of urban sprawl, the need to retrofit suburban settlements (Dunham-Jones and Williamson, 2008), the planning of resilient settlements in an evolving world, the idea of the countryside as a city, and socio-environmental planning. In the Chinese context, the concept of the harmonious development of communities is attracting research attention (Edmonds, 2012). The key concerns are the social problems, and the environmental degradation found both in the Chinese countryside and cities. In addition, the acute income inequality between urban areas and the poverty-stricken regions in China is an urgent issue to be addressed.

There are different types of regions and settlement patterns, according to Neuman (2000), and he acknowledges how regional design and the planning of territories interact. Neuman (2000) informs that basic regional settlement patterns are the rural hinterland, corridors, metropolitan; but in other literature, authors also refer to mega-city regions, urban fringe areas, mega-city corridors, 'urban' spaces, in-between and the mountain territories. Regardless of the evolving types of regional settlement patterns, a region has the same definition, i.e. a network of communities that can be concentrically organised, poly-centric, or dispersed, linked by post-fordist, modern communication and transportation systems whose surrounding is land that is less densely settled.

04. Designing the Urban Transition:

04.1_Nature-based solutions in designing an urban transition:

Traditional regional and urban planning practices emphasise spatial organisation involving transport infrastructure development, the growth of central business districts, and a functional zoning approach to land use planning. While not fully embraced in mainstream urban planning practices, the uptake of nature-based urban design and an ecology-driven urbanisation phase is gradually emerging in the planning and design disciplines. Initiated by the European Commission between 2014 and 2015, its report 'Nature-Based Solutions and Re-Naturing Cities' by the Horizon 2020 Expert Group recommends four principle goals and seven nature-based solutions providing directions for an EU Research and Innovation Policy agenda. The principle goals are transferable to other geographic contexts, and lessons can be learnt from its rationale. The EU aspires to be a world leader for nature-based solutions in research, innovation, and a green economy. The identified nature-based solutions involve sustainable urbanisation, environmental preservation, climate change adaptation, and disaster risk management. Therefore, the four principle goals are, firstly, the implementation of nature-based solutions to achieve sustainable urbanisation while supporting economic growth and the development of liveable cities for environmental and human well-being. Secondly, nature-based solutions are vital for restoring eco-system functions to both enhance resilience and address societal issues. Thirdly, the climate change challenge managed through nature-based solutions best relates to the idea of re-naturing cities. Fourthly, risk management using engineering-based solutions in combination with nature-based solutions can create better-diversified responses to risk management and mitigation. Consequently, the European Commission outlines seven research and innovation areas for nature-based solutions: Advancing urban regeneration, securing coastal region resilience, multi-functional approaches for watershed management and the restoring of eco-system services, sustainable uses of natural resources and clean energy, green infrastructure as protection against unanticipated shocks and the upscaling of carbon sequestration in the natural and human settlement spaces (Kopsieker, Gerritsen, S tainforth, Lucic, Costa Domingo, Naumann, Röschel and Davis, 2021).

04.2_Critical Blue-Green infrastructure development:

Evolving from the nature-based approaches to territorial planning, the innovation of critical infrastructure relates directly to the rethinking of blue-green infrastructure projects. Natural disaster mitigation infrastructure development is frequently associated with engineered canals, belowground pipes, water reservoirs, water filtration plants, concrete sea walls, retaining and dams. Such grey infrastructure types remain critical infrastructure provisions for flood risk management, avalanches, mud and landslides, and drought (Sebesvari, Woelki, Walz, Sudmeier-Rieux, Sandholz, Tol, García, Blackwood, and Renaud, 2019). In addition to acute environmental shocks, slower-burning environmental stresses are climate change, air pollution, ground and surface water contamination, biodiversity loss, water scarcity, and degradation of fertile soil for food production. Societal stresses may include a public health crisis, global pandemics, mental health issues, community and social network fragmentation, and inadequate care for an ageing population and vulnerable members of society. The limitation of grey infrastructures is the often fixed and static nature of the infrastructure with limited possibilities to adapt to changing environmental disruptions and society's constantly evolving needs.

Furthermore, grey infrastructures tend to be designed for only a few functions, hence, constrained to managing few risks. Both acute and slow-burning stresses can transcend geographic boundaries and spread into different regions in some cases be unnoticed. In addition to grey infrastructures, the development of critical blue-green infrastructures can address some of the required improvements of disaster mitigation measures. Some of the nature-based solutions that blue-green infrastructures offer are water decontamination, watershed management, air purification, noise reduction, habitat preservation for biodiversity and opportunities for food production. Critical blue-green infrastructure project types at the regional and territory scale include Greenway networks along transport infrastructure, green belt zones, primary farmland protection zones, permeable road paving, the restoration of riparian water edge zones, ecological corridors, micro-urban forests, urban wetland zones, rainwater collection open spaces and also multi-species farming land. Nature-based solutions for critical blue-green infrastructure development and eco-system resilience-building offer more significant opportunities for adaptation to changing environmental conditions and multiple functions compared to grey infrastructures. Natural disaster mitigation in the future will be based on combinations between grey, blue and green infrastructures to maximise environmental preservation, the maintenance of ecosystem function, and the evolution of inhabitable urban-rural territories (European Environment Agency, 2021).

04.3_Balancing social, environmental and economic objectives:

A largely under-researched issue is how to incorporate social considerations as part of multi-functional, nature-based critical infrastructure development. More knowledge is required for the design considerations concerning socio-environmental protection. Meanwhile, limited attention is paid to improving community networks and how nature-based planning approaches could alleviate poverty, for example.

Nature-based design proposals considering people and family structures are in its infancy, nevertheless crucial for a balanced evolution of people living in their territories. Nature-based improvements to settlement structures can impact public health, sanitation, and dignified living conditions. Ecological protection and preservation of fertile soil have direct and indirect positive impacts on mental health and

community cohesion and the provision of recreational spaces which may integrate local farming, healthy food production and consumption. Reintroducing local food production and consumption are possibilities for community collaborations. Economic activities related to farming and broadly cultivation of land are agricultural tourism and nature reserve exploration.

Furthermore, preserving local cultural identities, traditions, and customs can offer choices for diversification, to create distinct economic ecologies. Ultimately, such livelihood activities may deliver improvements to social relationships and the building of people-to-people support structures. To this end, the strategic implementation of nature-based solutions, whether blue, green, grey or hybrid infrastructures, becomes relevant to yield the most effective benefits for humans and biodiversity. A carefully balanced selection of nature-based planning measures to best promote green economic growth and long-term resilience may involve a continuous adaptation and modulation of the critical blue-green infrastructures.

04.4_Moving Beyond Contingency planning and Risk management:

For achieving the UN sustainable development goals and liveable cities, as a strategy, this research framework integrates three fundamental topics requiring continuous innovation, human ingenuity and investment: Firstly, at the community scale and in the case of individual families, the building of diversified livelihood activities would give people an improved resilience to cope with an unexpected economic retrenchment for instance. Secondly, community-scale livelihood ecologies and the planning of settlements encompass combining social and nature-based design considerations. Thirdly, once self-perpetuating livelihood ecologies have been set in place and habitats are better equipped with nature-based disaster reduction risk measures, the next stage implies a further transitioning to green economies. Such a transition entails inherent adaptation and spare capacities to absorb natural disasters, systemic or economic shocks. Urban and regional transformations will have moved beyond merely contingency planning and risk management at such an advanced stage. Consequently, cities would be able to cater for human equitable life for people and biodiversity. To move towards future sustainable urban transitions, the development of critical blue-green infrastructure and social welfare infrastructure for communities are fundamental needs to be progressed. Ultimately, the mission should be to achieve natural resource reserves and hence spare capacities.

Critical blue-green infrastructure would include creating additional multi-functional water reservoirs, parks designed for flood risk scenarios, planting trees, increasing the vegetative coverage in the settlements, and renewable energy generation. As part of the measures for implementing social welfare functions in the disadvantaged settlements, the following design recommendations can be made: The recycling of existing, underutilised buildings into community walk-in clinics, sports and rehabilitation centres, kindergartens, mother & child care centres, a community library and a computer learning centre. In addition to preparing an environmental and welfare infrastructure, individuals' ambitions, determination, and prospects for a better future are as important as their ability to build new economic ecologies. For the maturing of a community as part of a sustainable development project, it is equally essential for the citizen to rethink their daily life (Knierbein& Viderman,2018) at the grassroots level. Community participation instead of inertia and individual citizens' engagement in improving existing living conditions in settlements plays a crucial role. Existential global issues, including the environmental crisis, poverty, water shortage and food insecurity, also impact the quality of life in remote, disadvantaged areas. In particular, socially and economically vulnerable people and their families are

most affected by competition for resources. Hence, the support and a social welfare system for individuals in need within a community are necessary for forming self-sufficient communities.

The inevitability to reverse the process of fast-paced global urbanisation and further development of rural areas calls for self-sustained planning as part of regional design projects. While respecting the environmental carrying capacities, the embedding of new rationalisations and new livelihood activities in territories suggests a trajectory to evolve an alternative urbanity. In China's case, for the remediation of fragmented rural-urban territories, incremental top-down and bottom-up planning methods informed by recently completed design projects gradually promote further knowledge in the field of blue-green critical infrastructure research. Pertaining to the knowledge creation in this field, cartographic studies help to understand better underlying natural environmental and local livelihood ecologies in territories. However, caused by fast-paced urbanization, natural continuities in eco-system functions without disruptions can no longer be taken for granted. Eco-system stabilities are disrupted and fractured due to human intervention in the environment. Additionally, digitization & new geographies have increasingly altered human livelihood activities and their transactions in space and time. Therefore, remediation of fragmented eco-system services is recognized as a priority for a new-type urbanisation. Additionally, localised inclusions and overlays of recent technological innovations are becoming indispensable and integral to sustainable settlement development. However, innovative rationalisations are more difficult to implement in the hinterland of Chinese Mega-cities, where limited resources, uncoordinated industrial and agricultural hybrid uses of land have damaged the natural environment.

By embedding self-sufficient economic activities, low-density settlements that avert an overdependence on larger cities and resists the exploitation of resources by a metropolis may grow into an independent city. An eco-friendly and socially-conscious community growth, as an alternative type city, abandoning a 'business as usual' pattern of development, would be based on a different set of values than under economic growth-centred urbanisation. Its community members would prioritise environmental protection, health and sanitation, human capital formation, and cultural production.

As the urbanisation of rural areas is still regarded as a solution for maintaining economic growth in China, a change of development priorities will require more time to mature. Increasing the number of medium and small size cities in China in the near future will negatively affect the environment, resource consumption and the burdening of existing infrastructural networks. While China is transitioning into a phase of economic retrenchment, it is likely, that unintended, negative consequences of new urban construction impacting people, biodiversity, and the environment may cause further damage in the next decade. Therefore, the development of small and medium-sized cities, which consider economic productivity and environmental remediation, the well-being and social welfare for people, and respect local ethnic cultures would be a more evolved, next stage of urbanisation.

China's National New-Type Urbanization Plan (NTUP) for 2014-2020, a well-intentioned policy, can form a basic set of principles for a better phase of urbanisation. The NTUP objectives include balanced urban-rural development, coordinated regional development, environmentally friendly and sustainable urbanisation, biodiversity preservation, food security, poverty alleviation, and the preservation of ethnic identities. For the research by design studies in this research project, the following priorities in line with the NTUP have been emphasised: Renewable energy generation, pollution reduction, access to education, food production at small-scale farm level, welfare safety net building at the community level, economic diversification and ethnic, cultural tourism promotion. However, due to the relatively short period given by the official National New-Type Urbanization Plan for 2014-2020, an alternative planning

strategy considering a long-term impact recommends the ongoing updating of the development priorities and innovation of a Repertoire of Alternative Interventions in territories.

The principle of maintaining alternative possibilities (Frankfurt, 2014) applies to all scales of spatial planning: the individual family farm scale, village community scale, small, medium, large cities and the regional scale. Thus, it is understandable that transforming the urbanisation objectives and abandoning unsustainable development patterns requires bottom-up civic engagement and top-down sustainable development policy implementation. Hence, reinstating ecological and community stability in in-between and remote regions a period until at least 2050 and beyond may give a better prospect for forming people-oriented cities. Further, two crucial additional aims for a new urbanisation phase are implementing the NTUP objectives, not only as a high-level policy document but also as concrete regional design projects by planning professionals, and the livelihood activities in co-produced settlements by its people and the community administrations.

Similarly, the ideal condition of independence and emancipation of peripheral settlements can only be achieved by community participation, synergies between people and the protection of vulnerable members of society. Changes in livelihood choices beginning at grassroots level initiatives of individuals and smaller groups of people must not be underestimated in terms of the positive impact on the entire community. However, the up-scaling of transformative initiatives at the community level will depend on the organisation of people into mutually supporting networks working towards the common goal of everyday life improvements and economic betterment. The consolidation of efforts with other peripheral community networks can reinforce the scale of endeavours, social cohesion, and protection of common interests. For achieving a level playing field with neighbouring settlements communities that may have reached more mature stages of urban development, the advancement of human capital formation and ongoing protection of shared ecological capital is a vital shared interest. Consequently, an independently developing emerging community will self-perpetuate its local economy and simultaneously engage in economic transactions with other cities.

As emancipation in spatial planning is attracting attention from architects and urban planners, it can be anticipated that the enabling of Self-sufficiency planning in urban projects will gain momentum in the future. Given the challenges imposed by global economic and environmental struggles in marginal regions, its populations will likely protest against or reject the causes of spatial injustice and economic deprivation in peripheral communities. In particular, in China, well-being, intellectual growth, and the possibility to live in ecology-friendly urban environments continue to be a requirement for an increasingly educated and modern civilisation. The resettlement of migrant citizens into new towns or their origin is also an urban and planning policy challenge requiring good design and planning proposals. Safe, dignified environments for working, living and environmentally friendly city design for sustainable development of next-generation communities will be the priority. With a re-orientation away from the concentration of development in the coastal cities, allocating resources to the rejuvenation of impoverished, land-locked settlements could be supported by the transfer of technological knowledge into the remote. With the possibilities offered by recent developments in agronomy, new mobility and communication systems, the transformation of landlocked territories into an alternative urbanity could materialise in the future.

A genuine concern for social and environmental issues supported by investment into schools, hospitals, community centres, clean energy and water purification plants in communities will be instrumental for poverty alleviation. In keeping with the idea of maintaining the independence of emerging cities and forming new synergies with neighbouring settlements, an ultimate result may be a fair and just

integration of in-between territories into mega-city clusters. In this way, a distinction between 'centre' and 'periphery' may gradually be dissolved.

05. Conclusions:

To achieve blue-green critical infrastructure innovation, this paper proposes nature-based adaptations of regional planning methods, which consider environmental carrying capacities and the restoring of natural resource spare capacities. Crucial to revisiting the regional planning methods is to re-nature divided territories and fractured socio-environmental ecologies. It is pertinent to abandon binary distinctions between 'natural' and 'anthropogenic' ecologies for an integrated way of conceiving sustainability-driven regional planning projects. The contemporary regional design practice questions the segregation of regions into 'city' and 'countryside'. As elaborated in the paper, the rethinking of the regional planning approaches as a series of interdependent ecology types with fluid boundaries in networks instead of 'zones' is a non-binary alternative, in line with the notion of territories with no artificial dividing boundaries. Furthermore, a nature-based approach that considers the unequal relationships between the 'centre' and 'periphery' of territories seeks to rebalance access to ecological, social and economic resources, favouring balanced socio-environmental development.

The challenge to develop independent economic ecologies in remote territories through regional planning has become an ever more difficult task for regional planners. Although regional design for peripheral territories became more challenging due to short-term economic cycles, new opportunities for overcoming barriers for access to information, education and opportunities for reducing transportation time for people and goods continue to be improved. The sources that make balanced rural-to-urban development problematic are the global competition for resources and increasingly fragmented natural eco-systems. The reassessment of design problems in metropolitan cities and the methods for resolving urban design projects adopt innovative concepts and methodologies more rapidly than innovations for regional planning projects. Currently, topical research fields in urbanism not to be overlooked would be the development of digital twins of cities, the implementation of innovative city concepts and the use of cloud computing to predict the energy use of households, consumer behaviour, or crowd movement of people in cities. However, due to the comparatively lower investment in regional research by governments and private corporations, which are focused on global cities as economic engines, the innovation in regional design methods receives limited attention.

Re-establishing linkages between territories, people, livelihood activities and natural resource extractions would be an ideal restorative transition. Nonetheless, when studying large-scale spatial configurations, for instance, natural eco-systems no longer manifest continuity. Specifically, in regions with new transport infrastructural overlays, high-speed rail networks, water-diversion aqueducts and newly developed settlements, divisions, boundaries and discontinuities of ecological systems are inherent. Additionally, the internet has enabled the pursuance of livelihood activities remotely. Hence, such technological overlay is disconnecting people from the environment they inhabit and places of resource extractions.

Although an urban-rural gradient land use pattern is an idealised vision, the aspiration of designing seamless urban-rural transitions is relevant in fragmented territories and ecologies. At the urban planning scale, better linking of open green spaces, farmland and parks with settlement areas underscores the need to diminish segregations between built-up settlement areas and cultivated land and recreational

green amenity areas. The dissolving of artificial boundaries involves increasing vegetative coverage by creating parks on underutilised plots of land between buildings, planting trees along roads and the perimeters of plots, and planting on building roofs and walls. Nature-based urban planning approaches also consider the material physical assets such as uncultivated land, agricultural plots, forests, hydrological system, buildings, developable land and inhabitants. For a nature-based regional development approach, the liveability of the environment and habitability of settlements is a vital consideration for planning projects.

Last but not least, urgent issues include the provision of social services, community centres, health care, provision of education, elderly care, affordable housing, sanitation, environmental remediation, reduction of pollution, investment into green infrastructure and renewable energy technologies. Ultimately, the creation of welfare infrastructure in settlements would create settlements where the well-being of people matters. Combined with the embedding of new technologies and ITC platform-based networks, nature-based approaches constitute instrumental strategies for addressing a restorative transformation of territories. The hybrid design methods emphasise the necessity to consider planning problems comprehensively, paying attention to the transactional exchanges of remote territories with Mega-city clusters while constructing scenarios that promote an independent development of resilient settlements. In particular, the Pearl River Delta (PRD), undergoing a large-scale transformation as part of the Greater Bay Strategic Plan, focuses on developing new economic centres within the Mega-city cluster. As the Greater Bay Plan emphasises the development of cities with specialisations within the PRD, a mega-city scale nature-based approach that captures the River Delta and the Mountain regions in the hinterland could raise more awareness of overlooked, in-between and peripheral territories. Looking forward, it is hoped, the quality of the environment, decent housing, health and well-being of people will be priorities driving the forth-coming phases of urbanisation in Asia.

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