Transformations of Urban Fabric and Resilience Building

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ABSTRACT **In several parts of the world, global flows of capital are triggering rapid transformations of the urban fabric and the rural hinterlands. The effects of real-estate acquisitions by foreign investors and market-driven development can be witnessed with the emergence of regenerated city districts and the urbanisation of city fringe areas. The chapter explores some of the non-market oriented development patterns needed to support sustainable urban transformations. The objective is to reconsider urban development driven by an ecologically conscious approach which could lead to a resilient urban fabric. The networks binding together urban and rural settlement spaces is highlighted. Interrelations facilitate exchanges of resources, capital, and information. Such networks establish an underlying system that supports the cohesion of urban and rural communities. Urban growth, limited to mainly the development of real estate investments, does not deliver resilient and people-friendly built environments. Instead, urban development objectives need to include sustainable resource management, support for biodiversity, and develop food production capabilities. Given the global issues such as climate change and massive human migration towards cities, the capacity to adapt to environmental pressures becomes vital. To replace short-term growth objectives with long-term sustainability agendas, behavioural changes incentivised by ecological compensation schemes are considered.**

KEYWORDS urban transformations, networks, development objectives, ecology, resilience

1 Introduction

The growing awareness of urban development driven by short-term economic growth objectives is a serious issue being discussed in several disciplines (Bloom, Canning, & Fink, 2008): urbanisation processes since the 1944 *Bretton Woods Agreements* on new currency management systems (Van Dormael, 1978); the internationalisation of post-industrial capitalism; the end of the Cold War (Frank & Gills, 1996); and the globalisation of financial markets have gradually influenced the characteristics of metropolitan city development.

In the 1980s, the idea of globalisation began to be used to describe exchanges of goods, services capital, and information transcending national boundaries (IMF, 2008). Cities have become the 'command centres' (Sassen, 1991) for multinational corporations attracting international talent and foreign direct investments. According to the economists David Dollar and Aart Kraay (2004), globalisation has helped to reduce poverty and income inequality. Their study shows that during the 1990s, in the countries that embraced globalisation, the per capita income increased three-and-a-half times faster than in countries that did not rapidly adapt to a globalised economic system (IMF, 2008).

While a liberalised global economy has lifted millions of people out of extreme poverty, critics of globalisation highlight the fact that an internationally integrated economy benefits the independently wealthy while the salaries of all income groups do not increase significantly (Chatham House, 2015). Some of the negative impacts are the exploitation of a low-income workforce by multinational firms in underdeveloped countries. In parallel, employment opportunities in developed nations are being eroded by employing low paid workers in emerging economies.

This chapter draws on discussions and research findings from on-the-topic literature, synthesising the discourse on global issues affecting resilience in territories and urban transformations taking place. Section 2 introduces the causes of global issues affecting society, the environment, and the economy. It discusses some of the international capacity-building for resilient cities that is taking place. Section 3 describes how rapid, uncoordinated urbanisation impacts the environment. This section explains the idea of ecology and space as capital to be protected. Section 4 handles the changes taking place in food production systems, and adaptations of agricultural settlements. Section 5 presents possible directions for biodiversity preservation. Section 6 unfolds the more responsible use of depleting ecological capital. Finally, section 7 explains how multi-functionality in ecological and social networks may contribute to the building of resilience in territories, and the transformations of urban fabric.

2 Contextualisation

The 2008 global financial crisis (Patomaki, 2009) has increased the public awareness of the fragility of the international networks of transnational investment transactions and the banking systems. On the one hand, the internationalisation of emerging markets can support the development of poorer nations; on the other hand, the interdependence of markets can cause damages to developing economies during a slow-down of the global economy. The phenomenon of an accelerated integration of global markets calls into question the underlying principles driving short-term economic growth objectives, and the long-term sustainability of urban development projects.

The urbanisation processes that overemphasise the development of new super-prime residential developments seek to attract foreign capital from the wealthy of the globalised economy. This trend has negative impacts on low- and middle-income communities in cities. Urgent concerns are the inadequate preservation of environmental resources in urbanised areas, potential risks of a global food price crisis (Headey & Fan, 2010), and the protection of habitat for biodiversity. The narrow focus on land use for property development does not take into account environmental pressures of future climate change, flood risk, soil erosion, and pollution. The making of cities, which takes into consideration adaptive capacities for an unanticipated crisis such as human migration, variable economic cycles, and the effects of climate change on the environment, have now become an urgent aspect for sustainable urbanisation.

The geographer and political economist David Harvey (2014, para.6), states that "Urbanization has increasingly constituted a primary site of endless capital accumulation that visits its own forms of barbarism and violence on whole populations in the name of profit. Urbanization has become the centre of overwhelming economic activity on a planetary scale never before seen in human history".

His words describe the acute imbalance in development priorities, which drive the current urbanisation pattern. Harvey points at the Chinese experience which has dominated the urbanisation process for the past thirty years. Examples of real estate development in cities such as Dubai, London, and Mumbai indicate similar trends. The ever-growing expansion of mega-cities, swallowing peri-urban and rural areas for the purpose of economic growth, is expelling communities (Sassen, 2014), reducing sites for food production, and deteriorating the habitat for biodiversity.

Accordingly, adverse urban phenomena leave territories in a state of crisis (Bianchetti, Cogato Lanza, Kercuku, Sampieri, & Voghera, 2015). It causes dissatisfaction to communities (Harvey, 2014) struggling to maintain dignified livelihoods in overdeveloped cities. Evidently, the long-term future recovery of 'territories in crisis' would suggest the need for an overhaul of the urban development pattern. A paradigm shift based on human values and sustainable priorities for development

are being proposed at policy level by emerging global superpowers as China. Although the concept of a sustainable city has a longer tradition in western urban theory (Grober, 2012), it is still a relatively recent concept adopted in the Chinese urbanisation policy (Wang, Hui, Choguill, & Jia, 2015). In similar ways, global issues are affecting urban areas in different continents regardless of the maturity of a national economy. Measures designed to implement behavioural change and sustainability-oriented urbanisation policies are gradually being embraced in emerging economies such as Africa (Messerli & Messerli, 2008), where urbanisation may be a relatively recent phenomenon.

While issues transcending national boundaries persist, each geographic region has specific circumstances for which particular resilience strategies are being developed as part of national policies and international cross-border agreements (EC, 2017; Gualini, 2003). Given the complex interconnectedness and interdependencies of cities, new analytical and thinking skills for future urban innovation are necessary, as well as an integrative approach to urban planning. In the midst of the intricate networks interwoven with agricultural land mosaics, ecological landscapes, parts of urban fabric, dispersed forms of human settlements, and uncultivated land, it is increasingly challenging to analyse the multiple layers of ecologies and land uses that have an impact on territories.

2.1 Causes, Issues and Capacity Building

The identification of the causes for environmental and social distress in cities can only be accomplished with a multi-disciplinary team of specialists. Deep research into the underlying network and systemic features for a particular territory suggests the need for a case-by-case methodology for analysis. Comparison of innovative strategies and ideas applied in different countries are important steps toward assessing the feasibility and resilience of building projects. Capacity building and international transfer of knowledge is being promoted by organisations such as the Rockefeller Foundation with the *100 Resilient Cities* movement. Exchanges of information and insights are rapidly adding to this body of knowledge internationally. Replacing the destructive objectives driving urban development with green and socially responsible agendas becomes a key purpose for long-lasting city transformations.

Moreover, the embedding of new cross-border ecological corridors between city and countryside for enhancing territorial resilience and productivity must be explored. Certainly, a comprehensive understanding of the negative and positive externalities affecting the integrity of territories is essential. A critical part of an ecology-restructuring endeavour is to identify the causes of the regional transformations that are taking place (Milman & Short, 2008). Resilience appraisals may help to better understand the strengths and weaknesses of a territory in distress. By addressing the vulnerabilities of settlements (Rodin, 2014), higher degrees of resilience could be achieved. The rebuilding

of ecological continuities by remediating and opening up environmental corridors may play a vital role. This could be achieved, for example, through the extension of the edges of hedgerows and green amenity strips of land along transportation networks at the transitional zones between urban and rural areas, to amplify the benefits of ecosystem functions for settlements and biodiversity (Forman & Baudry, 1984).

The overhauling of distressed settlements into productive territories is a rapidly growing research field (Nelson, 2009). Fundamental to the aim for the longevity and resilience of settlements is the need for the perpetual adaptation of the survival tactics, and livelihood strategies, of communities. Further sustainable use of resources and the protection of the environment from external pressures must be stressed as the necessary future direction. Human activities and migration, in a web of global economic transactions, are creating new challenges for the adaptive capacities of cities. As societies, economic cycles, and global systems of exploitation evolve over time, in parallel, the tactics for improving resilience and adaptive capacities need to evolve. Correspondingly, the adaptations rely on state-of-the-art ingenuity in social innovation, science, and environmental technologies (Preston, 2012). For instance, the transition from fossil fuel consumption to clean energy consumption in existing family dwellings may be an adaptation of settlements.

2.2 Concepts and Rationalisations

The ever-expanding urbanisation process worldwide is faced with the challenges of creating equal opportunities for all people, and the competition over limited resources. The following paragraphs outline some of the recurring discussions found in scholarly and policy research. While urban theories that describe urbanisation processes are helpful in understanding the complex phenomena, they are not absolute theorisations in the current chapter. In distinct cultural and academic traditions, differentiation of seasoned research interests may be found. Recurring themes of the ongoing urbanisation processes are the 'global' nature of the phenomenon, the increasing study of 'network' formations, and the relationships of 'urban-to-rural' areas.

In various research publications, the current processes of urbanisation are discussed under the rubric of the *Urban Age* (Burdett & Nowak, 2011) which is partly concerned with the population growth globally and migration of people into mega-city regions. While this trend has lifted millions of people out of poverty, it has also caused an uneven development of urban agglomerations, the countryside, and the 'in-between' territories. Rapid urban expansions cause pollution to environmental resources and disruptions to ecosystem services (The Worldwatch Institute, 2016). At the global scale, the urbanisation activities that transcend state-territorial boundaries are also being studied and theorised as the phenomenon of a planetary urbanisation process (Brenner, 2014).

Propelled by internationalisation, the immaterial flows of capital, information and specialist experts are forming networks of exchanges and knowledge ecologies (Bathelt, Malmberg, & Maskell, 2004). Such global flows of knowledge have little or, in some cases, no relationship to settlement spaces or the environment. The detachment of globalised economic activities from territories leaves some communities behind - in terms of development and progress. This is causing social, economic, and environmental degradation of settlements.

In some cities, high-density urban development may contribute to sustainability by sharing common urban infrastructures, avoiding the duplication of expensive investments, rationalising the land-use and improving employment opportunities. Nonetheless, the negative externalities of densely developed urban areas are becoming an extreme problem for municipalities. The formation of dispersed settlements in urban areas, inadequate access to green amenity resources of nature, pollution, and spread of pathogens in high population neighbourhoods are some of the issues found in over-developed metropolitan areas.

In contrast to advocates of high density urban development, a long tradition of research into dispersed networks of urban fabric is gaining attention. The 'diffused city' (Indovina, 1990) which conceptualises an urban fabric of low-density settlements at the territorial scale represents an alternative and plausible form of urbanity.

The artificial boundary between urban and rural fabric is being redefined by a shift to an urban-rural continuum (Eppler, Fritsche, & Laaks, 2015) discourse of territories. The concept of the *Horizontal Metropolis* (Secchi & Viganò, 2013) is capitalising on the benefits of a dispersed urban fabric, environmental networks, and connectivity. In this particular type of urbanity, metropolitan and agricultural activities occur simultaneously. The binaries of the urban and rural are dissolved - while emphasising horizontally organised settlements, 'porosity' (referrring to the idea of accessibility in urban space and the removal of spatial segregations), and ecological infrastructure. It is conceived to enable a more sustainable approach to urbanisation and the building of environmental resilience. The provision of ecological resilience may, for example, mean the allowance of a spare capacity of river networks to be able to cope with the potential risk of flooding.

3 Uncoordinated Urbanisation of City-Territories and Impacts on the Environment

The *Sustainable Development Goals* (SDGs) for 2030 were adopted in 2015 by the United Nations. Eight of the official seventeen goals directly address environmental, inequality, and wellbeing concerns. The sustainability goal topics include poverty eradication, health, clean water, clean energy, sustainable cities, climate action, life in water, and life on land. The seventeenth goal emphasises the need to cooperate globally. "A successful sustainable development agenda

requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed." (UN, 2015, p. 26).

Greater cross-border cooperation, necessary for larger-scale regional urbanisation projects, would be in line with the SDGs for 2030. The speed of urbanisation results in uncoordinated development, distortions in economic cycles, and demographic instability. The steep decline of community resilience is an issue found in several metropolitan settlements globally (Wallace & Wallace, 2008). The inadequate preparation for potential disasters in urban agglomerations is a serious slow-burning stress (Button & Schuller, 2016; Rodin, 2014). It is a systemic issue likely to compromise the social cohesion and ecological stability in growing cities. In order to pre-empt social unrest, and to give support to distressed communities, the sharing of environmental resources, and reforms to the urbanisation pattern, need to be urgently implemented.

3.1 Evolving Nature of Urbanisation and Emerging Issues

The phenomenon of urbanization itself is highly adaptive to socio-economic, political and geographic conditions (Lambin & Meyfroidt, 2010). General characteristics of its occurrence are described below.

In its broadest sense, urbanisation is characterised by the extension of urban built-up areas and the migration of people from rural to urban areas (Wang, Garg, Smith & Tao, 2016). Nevertheless, each geographic region may experience urbanisation at a different speed, with different sets of issues, and it may be conditioned by local circumstances in space and time. Equally, it can be an evolution through adoption of urban behaviour by a rural population (Keeble & Tyler, 1995). For example, farmers may be utilising online retailing platforms to distribute organic agricultural produce to buyers living in metropolitan areas. In parallel, further stages of this movement can be a 'reurbanization' - which supports the redevelopment of land and retrofitting of buildings within cities. Other developments include the process of 'suburbanization', initiating the growth of settlements at the outer boundaries of cities (Carlino, 1985). Alternatively, the idea of 'counter-urbanization' suggests that people move from inner urban areas to rural areas and villages outside of cities (Hyun, 2010).

New, evolving types of urbanisation processes will create as yet unknown challenges. To engender better and more democratic forms of urbanities, the rethinking and new rationalisations of territories are needed. The global economic slow-down and state of environmental crisis urges the definition of new urban questions (Secchi, 2010). The escalating social-dualisation, the need to decarbonise energy generation, and the potential impacts of climate change create new problems for urban practitioners and policy makers. Solutions to these issues require flexibility, innovation, and insight.

Given the unavoidable global population growth expected in the next twenty to thirty years, major urban transformations need to be responsibly managed. Influencing such territorial transformations for the better should be a shared responsibility of society. Concerted efforts should benefit future generations. Deep systemic changes are taking place in the way that people choose to live and in how cities function (Lorek & Vergragt, 2015). Some of the changes comprise the transition from fossil fuel to clean energy consumption, and the idea of developing data-driven or 'smart-cities' to optimise the use of energy resources. For example, the use of Information and Communication Technologies (ICT) in rural, dispersed settlements outside of the main urban centres has a gradual, positive effect on the social and economic network support offered to developing territories. Evidently, this process of transformation opens up choices to adopt metropolitan ways of life outside of the larger urban agglomerations.

3.2 Ecological and Spatial Capital

New urban paradigms for a sustainable co-existence, resilient cities and community wellbeing are emerging. Liveability will not only be a result of accumulating capital and assets. More importantly, ecological, spatial capital and the ability to accommodate change will be determining factors. Resilience will be contingent on belonging to social support systems, people-to-people relationships, social capital (Secchi, 2006), and the ecological stability in new urbanised areas.

In other words, a crucial part for creating people-oriented and socially just urban development (Pieterse, 2013) is the provision of access to the environment, space and the equal right for all citizen to participate in urban life (Harvey, 2003). People suffering spatial injustice in territories (Soja, 1996) are often socially and economically marginalised. The accumulation of land and appropriation of environmental resources (Rulli, Saviori, & D'Odorico, 2013) by real estate investors create divisions between formal and informal urban developments. Processes such as natural resource extraction and land grabs become mechanisms for excluding people from different socio-economic or cultural backgrounds. The spatial strategies of segregation and integration (Secchi, 2010; Soja, 1996) are most evident in mega-cities. Some examples are the development of gated communities for the wealthy, or the forming of informal communities for people with no legal rights for settling in cities. Competing global cities seek to attract foreign capital into high-end residential developments (Wu, 2001). As a consequence, this development drives lower income and socially marginalised communities into peri-urban areas. Ultimately, people are forced to live in less desirable areas, away from their places of employment and the centres of economic activity.

Spatial capital is closely interrelated to the access to environmental capital (Blaschke, 2006). The quintessential resources such as daylight, air, water, open green space, farm land, and forestry are becoming scarce assets in highly urbanised areas (Sander & Zhao, 2015). Due to

the inadequate provision of environmental infrastructure in built-up areas, the absorption of pollutants, heat island effects, and urban ventilation become compromised.

For rural territories and the hinterlands, the eco-system services are a critical environmental capital. The environment provides indispensable environmental carrying capacities for both the countryside and metropolitan areas. To perpetuate life in cities, intrinsic environmental resources need to be protected from exploitation and overuse in the hinterlands. Uncoordinated urbanisation processes, human migration, and population growth impede on the environmental carrying capacities of eco-systems. The expansion of mega-city agglomerations need to be reorganised in a way to avoid unintended, irreversible consequences to the environment.

4 Adapting Urban Territories for Self-Sufficient Food Production and Transformations of Agricultural Settlements

The 2007/2008 food price crisis has highlighted the relevance of innovation in food production for territories (Sonnino & Beynon, 2015). Food security is recognised as a critical component of resilience building for settlements (Barthel & Isendahl, 2013) and urban transformation projects by governments, planners and design professionals. The expansion of urban areas is causing a reduction of land dedicated to agricultural activities. Additional negative aspects are the deterioration of soil for farming (McMichael, 2014) and a disconnection of communities with sites of food production (Turner, 2011).

Recent innovations in urban renewal projects attempt to reintroduce food production into cities, for instance by using green roof areas for growing vegetables (Specht et al., 2014). Giving the opportunity to households to carry out their own farming activities in cities helps to alleviate the burden of food insecurity for urban administrations. Supporting urban communities to take up agricultural activities plays a critical role in a wider sustainability agenda in metropolitan areas. Derelict urban plots and abandoned buildings are being utilised for farming (Tornaghi, 2014), as found in community rehabilitation projects by municipal administration, trapped in a decline of former industrial activities (Mah, 2012). Detroit is an example of a city in which communities reintroduce farming activities, due to the decline of the automobile industry (Daskalakis, Waldheim & Young, 2002). The rebuilding of livelihood strategies and greater control over food provision through farming could be ways to increase food security.

In parallel, there is a growing trend in which people living in cities are trying to reconnect with the rural hinterland (Sonnino & Beynon, 2015). New communication technologies enable greater optimisation and precision farming (Finn & Donovan, 2016) to be adopted by agricultural communities. Innovations in food production methods in rural areas

can occur at multiple levels. Larger scale community-wide agricultural consolidation and modernisation projects try to upscale agricultural production to achieve higher levels of efficiency. In other cases, urbanites with specialist ICT skills enter into subcontracted relationships with local farmers to disseminate the know-how to apply adaptive farming decisions based on data from soil, weather forecasts, the tracking of volatile commodity prices and market opportunities (Akhtar, Tse, Khan, & Rao-Nicholson, 2016). Better optimisation of farming can help to reduce financial losses and lift rural communities out of poverty (Bulte, Lipper, Stringer, & Zilberman, 2008). The innovations and the updating of food production practices bring about positive transformations in rural and urban areas.

5 Emerging Practices for Biodiversity Preservation

The urbanisation of nature reserves, if not planned carefully, diminishes the habitat for biodiversity sustenance. The preservation of ecosystem services, in which biodiversity can be nurtured and maintained, calls for a development approach in which the integrity of key ecological, topographical, and geographical features in territories will not be compromised by urbanisation (de Groot, van der Perk, Chiesura & Marguliew, 2000). The restoration of original ecosystem services plays an equally important role in mitigating further loss of biodiversity.

For instance, in densely developed urban centres, the mimicking of ecosystem service functions (Pedersen Zari, 2016) in the built environment could be achieved by retrofitting urban paving into permeable surfaces, utilising building envelopes for vertical greening, and installing vegetation substrates on roof surfaces (Oberndorfer et al., 2007). The recreation of eco-systems within developed settlements would be designed to attract vanishing and new species into cities to increase the density of biodiversity. Absorbing agricultural activities in cities may contribute to a diversification of farming produce and greening of the environment (Viljoen & Bohn, 2014). A sustainable transformation and renewal of urban fabric may be accomplished by avoiding the creation of boundaries between built environment and natural ecologies such as forests, hydrological systems, or agricultural land.

Urban renewal visions such as the *Greening of Detroit* mission, founded by Elizabeth Gordon Sachs in 1989, take the initiative to restore the arboricultural infrastructure in the city. Furthermore, a richer range of biodiversity species in flora and fauna may be promoted (Steffen, Grinevald, Crutzen, & McNeill, 2011) by the blending of biological ecologies, wild life, and ecologies of the anthropocene (Ellis, 2011). In other words, the recycling of land cultivated by human beings and the mixing of different uses of land may create diverse habitats for people and biodiversity. Projects such as the Manhattan *High Line* park and the *Garden by the Bay* in Singapore are paradigms for the creation of liveable environments for biodiversity (McDonnell & MacGregor-Fors, 2016). A diverse range of visions for more balanced

transformations of cities are being tried by designers, communities, and city administrations. Projects that look at restoring health and wellbeing for people, ecology, and wildlife may have a higher likelihood of becoming resilient environments.

City projects that do not consider the preservation of ecological capital for future generations may benefit from the advice by specialists in ecology (Hull, 2008). Next generation sustainability-driven ideas for the making of cities need to take into account resource conservation and eco-urbanisation (Wang, Deng & Wong, 2016). Projects impacting the ecology and settlements would consider an effective allocation of resources (Agrawal, 2001) to achieve long-term sustainability goals. Some examples are the investment into clean sources of energy, such as wind and solar power. By pursuing development, the inevitability of consuming environmental capital needs to be supplemented by giving back ecological infrastructure in territories which are deprived of ecological resources. This would imply the construction of new urban landscapes which can provide ecosystem services to cities (Andersson et al., 2014). Planning new urbanisation and economic corridors in remote, disadvantaged territories is unavoidable for sustainable development and poverty eradication. New linkages of urbanisation corridors need to act as platforms in which productive settlements can emerge and co-exist with ecology.

6 Responsible Use of Environmental Resources

Facing the issue of resource scarcity, new ideas on sharing ecological resources in disadvantaged territories are crucial in avoiding the full exhaustion of environmental space capacities (Burgess, 2000). Natural resource extraction, causing the full depletion of environmental capital, needs to be reconsidered. More efficient use of resources would require an approach based on sharing ecological resource, minimisation of waste, and the avoidance of overuse (Miller, 1995). Ecologically responsible resource extraction by businesses and communities can be influenced by society, policies, and education. Changes to consumption pattern in society start with adopting an environmentally significant behaviour of individuals (Stern, 2000). Larger scale systemic adjustments to induce an eco-centred economy require government interventions and international collaboration (Hubert, 2002).

New policies and eco-credit trading systems are emerging in an attempt to influence resource consumption (Saeed, 2004). Environmental credit systems are being tested to curb further pollution to air, water, soil, and to try to mitigate climate change (Poveda, 2011). Some of the measures are the establishment of sustainability point systems for businesses and individual households (Zeidan, Boechat & Fleury, 2015). Eco-credit systems, such as the EPA's air emissions trading program, allow businesses to offset emissions of pollutants by acquiring credits from more eco-friendly entities. Environmental policy frameworks protecting poor territories from resource extraction and

the environmental degradation caused by wealthier cities require regulation by environmental protection laws. Some of the known credit incentive systems are carbon, water, and land-use credit trading schemes (Muradian, Corbera, Pascual, Kosoy, & May, 2010). A further monetisation of sustainability-credits and environmental resources as water, clean air, and soil may help to raise awareness of the global issue of ecological resource depletion.

Additionally, programmes that are designed to guide organisations and people to adopt eco-friendly behaviour require further development. Environmental protection laws would need to be in place for pollution fines and penalties to be higher (Freeman et al., 1992) than the cost of installing decontamination facilities. In this way, an incremental transition to an environmentally responsible use of resources would be adopted by the industries and by society. Payments for ecological services and eco-compensation schemes (Zhang, Bennett, Kannan & Jin, 2010) are gradually being incorporated into national development policies in China, for example. Key standpoints are based on the idea that anyone who ruins the environment also needs to rehabilitate it; further, anyone who contaminates the environment should compensate for it financially (MEP, 2007; Zhang, Bennett, Kannan, & Jin, 2010).

Partly due to the increasing amount of solid waste produced in larger cities, territories outside the larger urban agglomerations will need to allocate reserves and sources of income for the reinstatement of health, welfare, and environmental remediation. Lower-income, economically-deprived territories struggle to fund adequate regeneration, infrastructure upgrading, and territorial reconstruction projects (Roberts, Sykes, & Granger, 2016). In order to counteract this vicious circle, resource protection programmes, policies, and environmental protection credit systems need to be incentivised. Rural territories will need to take measures to protect their environmental capital from uncontrolled overuse and contamination by pollution from intensive farming and more industrialised territories. This may be achieved through the establishment of more carefully considered interdependencies and reciprocal relationships between urbanised areas and rural territories. Policies imposing taxes on resource extraction and environmental pollution could generate funds and reduce further damage to the ecology (Freeman et al., 1992).

7 Multi-Functionality of Ecological and Community Networks

An innovative use of environmental, spatial, and social capital may be achieved by collaborative consumption in community networks. Compelled by economic constraints, a collaborative approach to consumption (Hamari, Sjöklint & Ukkonen, 2015), reuse, and recovery suggests a more responsible way of utilising resources. The concept of the circular economy implies a closed loop use of resources, in which resources are shared and reused (Stahel, 2016). Implicit in the idea of a

sharing economy are efficiency and optimised industrial processes that would minimise the waste of natural assets (Graedel, 1995). To avoid an unnecessary depletion of still natural rural wilderness, the conservation of habitat, reduction of industrial waste discharge, and pollution must be prioritised. People-to-people collaborations and social networks (Brecher, Childs & Cutler, 1993) can play a strategic role in collectively protecting the environment. For instance, agricultural towns in China, where communities collectively own and cultivate land, are one example for such networks (Wang, Garg, Smith & Tao, 2016).

To enhance the resilience of disadvantaged territories, it is necessary to understand the potentials of multi-functionality embedded in ecological and community networks. The idea of multi-functionality in networks is derived from the concept of multifunctional landscapes (Brandt & Vejre, 2004). As such, landscapes can carry agricultural activities, forestry, embedded social structures, wildlife, renewable energy, recreation, transport, and defence related functional capacities. Inherent characteristics and the strength in an ecological-social nexus need to be found. This would help increase the benefit from the positive multiplying effects of social-ecological networks.

For the multi-functional networks to become an enabling platform for community liveability and wellbeing, collaboration and sharing are key aspects for resilience building. The embedded supporting networks could constitute an underlying matrix of interactions, flows of goods, information, and resources triggering sustainable urban transformations. For territories that may have few natural resources, new multi-functional networks may be introduced as part of a sustainable development project. In other resource rich territories, some of the opportunities in networks may need to be rediscovered or revitalised by, for instance, considering new functional combinations (Hoffmann, Probst & Christinck, 2007).

Due to disintegrations of ecology, land, and communities as a result of city growth, a strategic reinstatement of continuities in ecosystem services and social networks with resilience attributes could be reinforced. A mutually favourable community where the environment, welfare support, and information sharing are actualised in multiple different ways may cater for a future-proof diversification.

The five key categories (Pérez-Soba et al., 2008) related to the multi-functionality of networks are described below. Relevant systems of production include the provision of food, clean energy, and materials. The environmental assets are air, water, soil, habitat for biodiversity, and land use. Possible economic opportunities are the diversification of income, creation of employment, as well as remote retailing, services, and online trading of agricultural produce. Social support and welfare benefits that can be enabled are health and wellbeing, housing, education, elderly-care, governance and administration, culture, and traditions. Some of the eco-system services potentials are the absorption of pollution, climate regulation, eco-system stability, flexibility, and recreation (Brandt & Vejre, 2004).

The idea of simultaneous functions of networks envisions combining physical and immaterial exchanges derived from social and ecological linkages in territories and rural areas. In its broadest sense, further elaboration of the concept of multi-functional networks gives scope to build in and improve the resilience (Young, 2010) of distressed settlements in crisis.

Caused by changing environmental conditions, the adaptive capacities (Preston, 2012) of territories to environmental pressures become an integral part of the ongoing urbanisation processes. Smart coping strategies that utilise cutting edge technologies and scientific advancements may become the drivers for resilient urban fabrics. To enable a rapid adaptation to environmental pressures, the sharing of information between communities and territories is central to maintaining sustainable livelihoods. Integrated networks of agricultural and urban communities can collaborate on the information gathering process from Big Data platforms. Greater precision in predicting potential environmental stresses is critical for transitioning to accurate environmental data collection and adaptive resilience strategies. Future urbanisation processes, which take into account potential ecological risks, could also adequately prepare for a shock absorbing capacity for unanticipated environmental stresses.

8 Conclusions

Disequilibria between city-territories emerge out of the unequal access to environmental resources, information that can improve livelihoods, and social connectivity. Uneven development between territories (Haughton, 1997) can be transformed by embedding multi-functional networks. Urban-rural transactional interdependencies necessitate a restructuring into transformative relationships (Peterson, 2009). In other words, relationships, which not only exchange resources, services, and information, can also make improvements to people's lives. Adjustments to the interdependencies could enhance the productive potential of territories for preparing sustainable environments. More equitable dependencies between wealthy and poor settlements will need to include ecological considerations to secure the health, wellbeing, and longevity of territories, while protecting ecological habitats.

The potentials for redefining networks from exploitative relationships to sharing transformational exchanges between underdeveloped and developed territories are not fully explored and thus, require more research. Implementation of policies that promote behavioural change, in line with the UN *Sustainable Development Goals* for 2030, commence at the level of people-to-people interactions. Linkages forming a web between human settlements and ecological habitat must be designed to be multi-functional – to support biodiversity, productivity, and the resilience of territories. The networks binding together ecological, urban, and industrial corridors would, because of their multi-functionality, be

able to adapt to changing circumstances and possible environmental disasters such as flooding or soil erosion due to wind.

The notion of resilience is being used in many disciplines including psychology, sociology, the environmental sciences, and urban studies (Southwick, Bonanno, Masten, Panter-Brick & Yehuda, 2014). Research has shown that several ecological systems can have a multiplicity of balanced conditions with varying degrees of system durability before disintegration occurs due to shocks (May, 1977). The idea of resilience being an attribute consisting of combined adaptive capacities (Quinlan, Berbés-Blázquez, Haider & Peterson, 2015) implies a multitude of strength properties needed to sustain resilience. The instrumental role of synthesised ecological, virtual, and social networks in preparing for emergent urban phenomena and challenges lies in their ability to maintain malleability and therefore, establishing improved stabilities. A sustainable transformation of urban fabric and ecology may go hand-in-hand with the building up of adaptive capacities and the resilience for several different types of human endeavours.

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