edited by Agnès Deboulet
and Waleed Mansour

MIDDLE EASTERN CITIES IN A TIME OF CLIMATE CRISIS

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Middle Eastern Cities in a Time of Climate Crisis

Agnès Deboulet and Waleed Mansour (dir.)

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ABSTRACTS

The climate crisis is hitting around the world, including in the Middle East and its cities. Urban regions are exposed to increasingly frequent heat waves and floods that leave decision makers without immediate answers. In the context of this global crisis, this book addresses the need for a better understanding of the current model of urban expansion. Cities are major sources of greenhouse gas (GHG) emissions but they are also celebrated for their contribution to economic growth. The current moment is one of a large paradigm shift as climate change is now recognized as a legitimate public problem. This is especially true for city dwellers, who are increasingly exposed to climate change, the loss of biodiversity and heavy pollution while natural breathing spaces continue to shrink around them. The sixteen chapters of this book do not offer any off-the-rack or technical solutions, but they analyze the urban conundrum and the contribution of cities to the climate crisis. Some chapters focus on individual car ownership, land privatization, waste management and land use changes under the guise of development. Others explore local and contextual answers to urban governance issues. With the support of CEDEJ and the Friedrich-Ebert-Stiftung, researchers, experts and civil society actors explore the ongoing transformations of Middle Eastern urban environments and mobilities and question them in relation to the climate crisis. The contributions are based on empirical knowledge gathered in the Nile Delta, the Greater Cairo Region, Riyadh and Beirut. Without concessions to mainstream thinking, this book contributes to a better understanding of urban challenges, climate threats and policy responses in contexts marked by growing environmental inequalities.

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The conference brought together thirty scholars and practitioners from the region and opened passionate exchanges with insightful thoughts and works about this delicate issue. It also highlighted meaningful solutions from urbanists, architects and sociologists working in the field of climate change and urbanism from the MENA region, Asia, Africa and Europe. The conference laid the foundation for an intellectual discourse and knowledge exchange based on local experiences from the cities presented as case studies. The FES Egypt office also trained young professionals through its Urban Lab Camp project, which touched on core issues of urban justice with a focus on mobility and transportation in cities.

We want to thank the Institut Français d'Égypte for its support during this joint conference and in particular David Reignier, Adrien Cluzet and Hany Hanna, a collaboration that started with the 2020 Sustainable Cities conference organized with David Ruffel. We are grateful to Richard Probst, director of FES Egypt for his support

these three years. This project is also a way to pursue the exchanges we started during the events undertaken by the Network for Urban Studies in Egypt (NUSE) and the events that took place within the framework of the Cairo Environment and Social Policies Seminar Series, through which we familiarized ourselves with urbanization and climate change issues. We would like to warmly thank Inès Anwar, Marie Vannetzel, Mehdi Labzaé, Omar al Tawansy and Ayda Yakout for their commitment at an earlier stage of the project and Pascal Menoret, the new director of CEDEJ, for his enthusiasm about this project and his wise revisions of some of these texts.

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AGNÈS DEBOULET AND WALEED MANSOUR*

INTRODUCTION
CITIES AND URBAN REGIONS: CENTRAL ACTORS IN THE CLIMATE CRISIS

In 2005, a report on disaster reduction warned of the increased risk for flash floods around the Red Sea and Southern Sinai (Government of Egypt 2005, 3).[1] There was, however, no mention of cities. In October 2015, unpredicted and devastating floods in Alexandria killed six people. In the winter of 2020, floods across Egypt affected 20,000 families and killed forty, with ten victims in Cairo alone (Reliefweb 2020); other informal sources mention even greater fatalities. In 2021, three people died and hundreds were injured by scorpions in Aswan, an event that was attributed by national experts to climate change (*Masrawy* 2021; see also Guillou 2021). Within the past decade, massive floods, reinforced by the predominance of concrete in Egypt's cities, have threatened the urban landscape and become a real obstacle

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1 We thank Sylvie Fanchette for her comments on this text.

to biodiversity. The lack of proper water drainage and weak coordination between public administrations and service providers only compounds the catastrophe.

Despite a brief reduction in carbon emissions after the outbreak of the COVID-19 pandemic in 2020, global net anthropogenic emissions reached an all-time high (UN News 2022), followed in 2022 by record heat, bringing with it unprecedented disasters. This comes despite earlier warnings by UN Secretary General António Guterres that emissions needed to be halved by 2030 and the global addiction to fossil fuels curbed. Agreeing that the 'fossil fuel industry is killing us', we must seriously consider the role of cities, which cause more than 70 per cent of human-caused emissions (UCCRN 2022), in the global climate crisis. Cities host 55 per cent of the world's population (UCCRN 2022), and their contribution to global warming could continue to rise as two thirds of the world will live in cities by 2050, up from about half now. Meanwhile, many cities are at the forefront of green reforms and will be key to tackling climate change, given that climate vulnerability is a shared global phenomenon and that various regions have different capacities to endure the consequences of climate change. If cities are generally much wealthier than the rest of the territory, a majority of dwellers in the Global South and in the Middle East are predicted to be severely hit by extreme heat waves, floods, loss of biodiversity and its consequences on air, water and soil quality (see El Hady in this volume), not to mention the cross-cutting risks of water shortages. 'Urban areas and their infrastructure are susceptible to both compounding and cascading risks arising from interactions between extreme events and increasing urbanization' (IPCC 2022b).

The situation in the Middle East will become dire because the region's countries and its cities are geographically located in areas of high average temperature, with most countries already marked by strong aridity. This will affect food security, since 70 per cent of agriculture is rain-fed (Borghesi and Ticci 2019). The region's population is also expected to double by 2070. These two trends may increase the dependence on food imports, making the whole region vulnerable to global price shocks; they may also cause or reinforce internal and international migrations of people seeking protection against extreme weather events and loss of agricultural productivity. Several specific

risks are expected to increase, harming cities and their populations and affecting not only the most underserved who live in precarious neighbourhoods, but also the most climate-vulnerable: children and the elderly (UNICEF 2022).

The region is also experiencing another strong transformation as demographic growth is taking place mostly in cities. The pace of spatial expansion is very high in Palestine, Egypt and Jordan but also in Lebanon, which continues to deal with an ongoing refugee crisis. Today the urbanization rate in the region is still rapidly increasing, with both strong patterns of migration to coastal cities and rapid natural population growth in others.

In addition to sectoral approaches, urbanism and urbanization stand as major social and systemic issues, worthy of inclusion in the UN Framework Convention on Climate Change (UNFCCC). As the population of cities double on average every twenty years and as cities continue to grow spatially, the link to climate change must be examined in two main directions. On the one hand, cities are producers of GHG emissions and, through the extensive use of extracted products, majorly responsible for environmental damages; on the other hand, cities are home to a majority of citizens and must offer viable alternatives to these emissions while supporting individual well-being and social justice. These interwoven challenges are unprecedented, and it was our aim to explore them in a collective volume.

This publication is a collection of scientific papers and essays touching on the urban realm of climate change in cities of the Middle East in relation to other global cities. The climate crisis does not wait, and this book is a modest tribute to the dramatic intellectual, practical and financial efforts that will need to be carried out in the next few years if we want to limit global warming to 1.5 °C above pre-industrial levels or, in the worst scenario, to 2.5–2.8 °C (UNEP 2022). In addition, this publication promotes critical thinking on the city's fabric, mobility and waste production. Its authors consider the city in relation to infrastructural developments in the productive spheres of the region's countries and to urban redevelopment at a larger territorial level. The 'urban' is no longer contained in cities and does manifest itself, even with unachieved citizenship or urbanity and outrageous rates of vacancy, through the complete built-up coverage of many

other territories. If Cairo's gated communities are meant to host a minority of its population, they nevertheless occupy 40 per cent of all land in the GCR region (Vilard 2022).

Let us try to briefly analyze the main factors and impacts of climate change and address its links with urbanization. We wish to touch upon decision-making mechanisms and to discuss climate-oriented planning. In this book, we understand climate change as a complex socio-economic and physical reality imposing itself on most aspects of social life, particularly in cities.

DESPITE COMMON SENSE: CLIMATE CHANGE FACTORS AND IMPACTS

Reducing global greenhouse gas emissions is often described in some countries of the Global South as being of the responsibility of the Global North. Climate change is a direct consequence of capitalist, state-led models of industrialization, post-industrialization and development; countries in the Global North have not yet respected their commitments towards countries that disproportionately shoulder the burden of the climate crisis. A major contradiction thus resides in the production modes and urbanization trends that, in the Middle East, have embraced this global trend of limitless growth, mostly manifested in suburban infrastructures that support oil-dependent individual mobility and related mega-projects. Accordingly, social and natural scientists have to venture into the critiques of both the financialization and technicalization of the discourses and solutions to climate change. The Anthropocene (Latour 2014) results in rapid changes that tend to make territories increasingly uninhabitable.

Let us first look at carbon dioxide (CO_2) emissions in the region. According to a 2019 IEMed report, such countries as Turkey, Israel or Libya were larger per capita emitters than some Southern European countries. Fossil-driven economies and war also have devastating impacts on the environment, the largest extractive powers of the region ranking among the most polluting and most polluted countries in the world. Adding to this reality, threats to animal and plant life indeed fit well under the umbrella term of a global 'biodiversity collapse'. This also means that the region's ecological footprint should be taken very seriously.

Our common assumption is that citizens lack control over the sources of pollution and the channels of solid waste disposal while a very strong path dependency on extractive industries now dominates urbanization models. In the region, and mostly in arid areas, the desert is seen by the state and developers as a reserve of wealth, but local authorities and citizens are mainly absent from this decision-making process, with the exception of Jordan and to some degree Lebanon and Kuwait. There is an intrinsic logic between the feeling of a land dominated by the desert (Sims 2014) and extended sprawl dedicated to the type of car-dependent urbanization that has existed for a while in the countries of the Persian Gulf (as shown here by Pascal Menoret). This logic, however, has become common sense in Cairo's urbanization (Sims and Zaazaa in this volume). The same applies to the concentration of hazards attributable to waste in cities; very few cities other than Cairo can boast the success of the informal Zabbaleen networks of waste collectors and recyclers (see Badir and Florin; Iskandar in this volume). These successes, however, do not prevent very heavy concentrations of fine particulate matter ($PM_{2.5}$) attributed to open waste burning (Larsen 2019). As climate change and urbanization are a multidisciplinary issue, we explore other areas of enquiry, including public health.

Many cities of the Middle East are coastal and survive on commercial trade. Climate-related disruptions can therefore result in economic and social problems that hamper their day-to-day activity. Moreover, other environmental challenges associated with overfishing or polluted waterfronts stem from the dire environmental situation and contribute to the rapidly rising costs of adaptation and to mortality and morbidity rates. According to the IPCC (2022a), the 'exposure of people, assets and infrastructure to climate hazards is increasing in Africa compounded by rapid urbanization, infrastructure deficit, and growing population in informal settlements'. The 2022 IPCC report reminds us that risks to coastal cities are projected to increase by at least one order of magnitude by 2100 if significant adaptation and mitigation action does not take place. The half of the Egyptian population that lives in the Nile Delta now faces rising sea levels, population expansion and degraded soil quality in addition to looming water shortages. This compounded risk

might cause a silent displacement of population as a result of climate change, and it already hampers food security. Two articles included here highlight this multifactorial structural change in the Nile Delta, caused as much by climate change as by a government-encouraged intensification of economic activities on fertile and wet lands. The initial vulnerability of river deltas that was originally also their source of wealth and fertility (see Fanchette in this volume) becomes a real hazard with sea-level rise, salinization and the rapid shrinking of lakes and wetlands. City centres are not as impacted as the peripheries, which undergo a never-ending process of land take. This suggests that vast urban regions in the Ecoumenopolis (Denis 2007) are characterized by massive local and international investments in land, turning them into urban sources of exchange value, something observed across Lebanon (see Public Works' contribution to this volume), in mega-cities and mega-city regions and beyond the Middle East (Huybrechts in this volume).

Current urbanization projections suggest that cities in the Global South, especially in East Asia, South Asia and Africa, could be at the receiving end of 96 per cent of an over three-billion-person increase in urban population by 2050 (Arku and Marais 2021). At the same time, many solutions introduced in those cities are serving European export markets, with large-scale investments and low responsiveness to local demands and challenges. Large infrastructural investments such as the creation of monorails, high-speed trains and fossil fuel-dependent means of transport may be warranted while and some localized cycling initiatives are burgeoning (Moussa in this volume). Yet almost no support is given to incentives for low or zero-carbon mobility, especially in mega-cities that have become unwalkable. In a way, the urban markets of mobility partake in the overwhelming dogma of auto-mobility, despite low levels of car ownership in comparison to Western European countries.

CITIES AND CLIMATE CHANGE IN LOCAL AGENDAS

The conversion of undeveloped land into urban land triggers local warming effects by altering the biophysical properties of the land surface, adding to non-local GHG-induced warming. Urban adaptation strategies seek to deliver local climate benefits by perturbing the

energy balance of the urban surface (Zhao 2018). Egypt represents the epitome of urban expansion presented as economic prosperity and urban development. According to an official government statement (El Sakty 2021), Egypt will soon witness the inauguration of its new capital. The new administrative capital project area is 168,000 acres in size, equivalent to the area of Singapore. It ostensibly uses benchmarks in construction and urban development from around the world. The same government source states, for example, that the new capital will contain a central park of 8 km^2, six times larger than Hyde Park in London. It will also feature an 'entertainment city' three-and-a-half times larger than that of Universal Studios (El Sakty 2021). What does that mean in terms of water and energy footprint? What kind of economy is this creating? Is this really the solution to such urban challenges as overpopulation and water shortages? Is this a sustainable model of urban governance?

Moreover, if social justice is to be aligned with solutions to climate change, this book clearly demonstrates that current urban developments fail to alleviate various housing crises (Shawkat 2020). Aggravated expansion in the form of gated communities, roads and infrastructure is a net contributor to the large cities' GHG emissions, as it is in other countries. The rapid pace of urban growth and real estate investments makes Egypt a pathfinder of over-urbanization without catering to the needs of the 60 per cent living in dilapidated or precarious neighbourhoods. We can assume that the politics of urban regeneration is clearly reinforcing these spatial and environmental inequalities. The new capital, accompanied by more than forty-five new cities in Egypt (see Sims in this volume), is the government's answer to the expansion of informal settlements, even if the reality of land markets does not tackle these populations' needs. New cities are encouraging urban sprawl through a 'Riyadh' or 'Los Angeles' model of urbanization that is entirely unsustainable. Many authors have written about the urban assets of precarious neighbourhoods, one of them being the density of the urban fabric. These writings have been ignored, as they seem to fundamentally challenge not only the urban dream of the self-segregated city but also the credit industry and models erected by the private housing sector, encouraged by various administrations and housing markets.

We therefore need to challenge the usual discourse on new eco-cities, which contradicts the reality on the ground and is not aimed at the majority. Moreover, new planned developments fail to answer the major question of internal mobility: their urban fabric is not designed to be walkable, and cars are often the only means of transportation. Let us remember that smart cities are a new investment field for international corporations and are therefore aligned with the 'developer's spirit' at the expense of compactness and social justice.

According to the current generation of researchers, housing renovation and urban upgrading could be effective tools, provided that they be monitored and co-managed by the affected communities. Yet this wish for an inclusive approach seems out of hand in the absence of elected or independent local bodies.[2] The current model of urban expansion is pointing to an economic model that is extractive rather than circular, even though Egypt's 2030 strategy promotes sustainable development in a cross-cutting approach with all government policies (MPED 2020). Urban expansion leads to consumption, production and an intensive use of water by the construction sector (see Zaazaa). This is followed by the increased energy demand generated by the construction sector, in addition to the creation of road networks and accompanying infrastructure. Expansion generates a radical climate impact in the form of emissions and urban heat islands (National Geographic Society 2022).

With more than 80 per cent of the global GDP generated in cities, urbanization could contribute to sustainable growth through increased productivity and innovation if managed well (World Bank 2022). In Greater Cairo, where over twenty million people live and work, the climate stress factors are increasing daily due to massive urbanization and over-motorization. Although Cairo is not directly threatened by rising sea levels, other climate factors can hit the city at a larger scale, for example flash floods and weather events, as well as deteriorating air quality and overheating due to a rapid increase in temperature and longer periods of heatwaves.[3]

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2 Regular local elections take place in Jordan, Kuwait and Lebanon.

3 The duration of heatwaves in Egypt is expected to increase (between 9 and 77 days) (UNICEF 2022, 10).

In the following pages, we will examine the logic and outcomes of the massive urbanization that stems mostly from financial motivations and worsens the environmental situation despite some success in the pursuit of Sustainable Development Goals.[4]

HOW DECISIONS ARE MADE

Despite an overall awareness of the looming climate crisis, tools for climate financing remain elusive. Green bonds are issued to finance large-scale infrastructure projects to build more bridges and bigger roads, thereby creating more disparities while ignoring environmental or social justice. Proceeds from Egyptian green bonds have supported fourteen infrastructure projects valued at USD 403.26 million. These projects can be grouped into two categories: monorails as a supposedly sustainable form of transport, and wastewater treatment plants in new urban communities. These projects, however, only mostly serve rapid urban expansion and magnify its climate impacts. Additional such investments can only make it harder to deal with the climate crisis.

With its social democratic views on climate change, the Friedrich-Ebert-Stiftung calls for a just, socio-ecological transformation in our cities and societies. However, this transition and the urgency of moving towards it can be either gradualist or emergency-based (Rode 2019). Gradualism as part of climate action refers to decarbonization over several decades. This approach includes net-zero emissions targets by 2050 and a range of economic policy instruments, for instance emissions trading and carbon taxes. This course of action could have been valid a decade ago, but it is framed instead by political and financial realism, a less productive alternative to a more responsible, scientific approach (Rode 2019).

4. In 2021, Egypt was among the ten countries that submitted a Voluntary National Review (VNR). In doing so, it strives to lay the foundations for a more resilient economy and community capable of weathering unexpected adverse shocks. It has also has taken some steps in the implementation of the SDGs by undertaking reforms in different areas (CAPMAS 2016). The Sustainable Development Strategy report also advised involving all stakeholders in the process from an early stage, ensuring a planning phase, and allowing each group of stakeholders to set their own indicators, baseline and targets.

Few infrastructural or adaptation plans are being developed through consultations with diverse and marginalized urban communities (for such a recent project, see Abosira et al. in this volume). In addition, many secondary settlements and precarious neighbourhoods 'need global support for local governance, more information and more direct sources of finance to meet the vision of global climate agreements' (IPCC 2022c, 921). In the case of Egypt, the choice has been made instead to further build out the road network and to construct monorails and high-speed lines through the desert, crossing the boundaries of both historic and modern city cores. As for many planning decisions globally, worsening predictions for climate and global emissions 'would require a prerequisite development of scenarios […] and development pathways' (IPCC 2022c, 921). This leads to a reflection on the absence of a participatory process in planning and climate-oriented decision making. Against this model, Aqaba and other Jordanian municipalities offer a chance for city resilience through real efforts for participatory planning, while Bethlehem and other cities in Palestine opened up spaces for a collective reflection on the role of public spaces and slow mobility. In Lebanon, land across the whole country is massively allocated to developers, neglecting the central role played by forests, wetlands and fields in the country's independence and its protection from the impacts of climate change (see Public Works' contribution to this book).

Within one decade, research on 'sustainable cities' has given place to a new concern for climate change. Ten years ago, CEDEJ dedicated a special issue of *Égypte/Monde Arabe* (Barthel and Monquid 2011) to contextual paths for sustainability. The authors took stock of the potentials of the inner city of Cairo which is overlooked by such mega-visions as the Cairo 2050 strategy, marked by disdain for high densities and a preference for a regeneration that is blind to the existing urban fabric. This vision is consistent with a competitive metropolitan agenda adopted by the major cities of the region (Deboulet et al. 2016). The lack of compromise with land resources and the environment squanders the last chances for the metropolis to have recovery spaces. Indeed, the speed of demolitions correlates with an unprecedented urban expansion, establishing the metropolis

within a widening urban corridor that leaves little consideration for the existing built areas, which are seen as out of date and unprofitable.

WAYS OUT, OR: SMART CITIES WON'T SAVE US

'Unless drastic action is taken to eliminate net emissions of greenhouse gases from human activity and remove historical emissions from the atmosphere, the impacts of global climate change will continue for a long time to come' (Mayrhuber et al. 2018). The consequences of exposure to extreme temperatures on human health are dire and lead to increased morbidity rates (WHO 2021). Climate change experts and political bodies have been inclined to position themselves on the debate between adaptation and mitigation. Our goal in this book is rather to enlarge our consideration for the reciprocal impacts of current urbanization and climate change.

We fully agree with the mounting pressures to adopt behaviours (both individual and for economic actors) that would drastically reduce net emissions and carbon footprints in all domains. Urban environments in the Middle East urge us to stop considering nature as a field for production, exploitation or profit. Protecting life and protecting the natural environment should be a priority.

Exposure to high temperatures over extended periods has become the rule in most of the Middle East. This is especially the case in cities where most building materials are made from concrete, reinforcing the internal heat exacerbated by lacking ventilation. Many authors have underlined the tendency to cut trees to widen roads and produce coal in Egypt. This has reduced green space per capita to 17 cm^2 in Cairo and 39 cm^2 in the cities of the Canal Region (EIPR 2022).

Empty spaces are pervaded by construction sites, even if the buildings themselves remain empty. Very high densities and the absence of cross-ventilation make daily life harder. Ghodbane's article in this volume demonstrates the capacity of ordinary dwellers to minimize heat when access to air conditioning is not possible. Their skills are nonetheless misunderstood by professional architects, while masons are more able to address their needs. This is a topic of concern for planning – several metropolises have adopted plans to combat heat and ambitious policies of 'no net-land take' (Huybrechts in this volume). It is of concern for the construction sector, too, which needs

major changes. Radical decarbonization through the use of such naturally sourced materials as straw and clay is now technically feasible and necessary.

Another example is air pollution (see El Gerzawy in this volume), whose public discussion is swept aside to the point that the vast majority of city-dwellers in the region is not informed about it. While some states do monitor air pollutants (Larsen 2019) in the region, access to information is limited and no local agenda has yet been set up. In many countries, there is a need for coordination between public health and urban authorities. While urban expansion is galloping and suburbanization becomes dominant, with its massive need for infrastructure, services and industries (Keil 2018), air quality and transparency will probably become a major public issue.

As noted above, the challenge is in the region's cities, given their rapid growth. Solutions will mostly come from within cities and increasingly from municipal and local authorities. Such international networks as the International Council for Local Environmental Initiatives (ICLEI) or United Cities and Local Governments (UCLG) may provide technical or ideological support for policy shifts that seek to change the way cities operate, convince them to reduce GHG emissions and preserve biodiversity (see Díaz-Bone in this volume). Considering the specificities of Middle Eastern cities and their high vulnerability to climate change, urgent and drastic measures are required, taking in consideration extant climate injustices. We must reconsider the use of purely technical one-size-fits-all strategies. The climate crisis is a human construct, and it would be vain to fight it only with technical solutions, without trying to adapt socio-technical arrangements and disrupt the entrenched 'system of automobility' (Urry 2004).

The FES's publication on *Managing Urbanization* (Brandi 2021) states that the 2030 agenda, together with the Paris Agreement, can help unlock the potential of cities as change agents in the climate agenda. A first goal is to align urbanization with the preservation of natural resources and the protection of the local environment by adhering to planetary limits. A second dimension is ensuring the social, political and economic inclusion of urban dwellers, which includes access to food, clean drinking water, sanitation and such basic

services as healthcare, education and jobs. Third, the privatization of the public sphere results in further inequalities and exclusion, as these spaces are meant to be a reserve of the biosphere (Brandi 2021). This third dimension relates to preserving the socio-cultural identity and spatial diversity of cities and urban societies.

The first part of the book addresses a range of urban climate crisis challenges in three main directions: urbanization, waste and housing. David Sims explores the relation between urban sprawl and low densities in Greater Cairo and analyses car-oriented mobility and its contribution to GHG emissions. Pascal Menoret looks at fossil energy dependency as a socio-political construct in Riyadh. Ahmed Zaazaa examines the current overproduction of high-end housing in Cairo and studies its 'environmental price'. Public Works Studio, a collective of urbanists and architects, writes on public land policy, privatization and instrumental re-classification as key to understanding ecological and livelihood losses in Lebanon. Sylvie Fanchette compares the Nile Delta with Asian Deltas, which are all exposed to high hazards and environmental deteriorations. Florian Bonnefoi studies coastal defences in the Nile Delta from the vantage point of adaptation and long-term resilience of cities and other fragile environments. Dalila Ghodbane looks at climate adaptation from the perspective of city-dwellers through low-tech building practices and considers the role of various building practitioners in climate resilience. Romani Badr and Bénédicte Florin write about waste pickers in Cairo; as waste remains a major source of emission and pollution, the mindful circular industry of the Zabbaleen calls for support and recognition.

The second part of the book offers fresh perspectives on recent civil society initiatives on climate emergency and urban challenges. León Díaz-Bone, representative of the ICLEI network of local authorities, proposes a pathway to take stock of Sustainable Development Goals and recent climate agreements. Nabeel El Hady writes on behalf of generations of students and delivers key messages for learning from water and biodiversity through nature-based solutions. Eric Huybrechts shares his perspective as a planner consulting with public agencies in many capitals and mega-cities. Layla Iskandar stresses the unique contribution of the Zabbaleen in creating a circular economy. Still not sufficient, this informal system has all the ingredients

for becoming a viable alternative. Heba Attia Moussa examines low-carbon mobility, especially biking, as an alternative to car and oil dependency, while thinking about the difficulties posed by slow mobility in suburban spaces, which European transfer models do not consider. Mohamed Abosira, Ibrahim Garcia, Iman Hassan, Kareem Ibrahim, Sara Sayed and Sara Seyam reflect on climate change- and gender-sensible design of public spaces in Damietta region. Two interventions by Ragia El-Gerzawy and Ahmed El Dorghamy respectively focus on the complex relation between air pollution and heat-island reduction with the climate crisis.

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PART I

OVER-CARBONIZATION AND ENVIRONMENTAL DEGRADATION: MIDDLE EASTERN CITIES AND URBAN REGIONS UNDER VITAL CONTRADICTIONS

DAVID SIMS*

GREATER CAIRO AND GREENHOUSE GAS EMISSIONS

Egypt has taken the threats of global climate change seriously. It has adopted all of the United Nations Framework Convention on Climate Change's (UNFCCC) protocols relating to global warming (in 1994, 2015, 2016 and 2017) and has incorporated global warming concerns in a range of national plans and visions, particularly Egypt's Vision 2030, the Long-Term Low Emission Development Strategy 2050 and the National Climate Change Strategy 2050 (UNFCCC 2022, 3). It has also taken a number of very visible measures to mitigate the production of greenhouse gases (GHGs) (such as a bold programme to promote renewable energy sources[1] and actions in the transportation sector), and it has implemented a number of measures to adapt to global warming (particularly to combat rising sea levels and salt intrusion in the Delta). However, there is one factor which seems to have been ignored: the creation and expansion of sprawling urban settlements in Egypt's deserts, especially around Cairo. It is this factor that will, over the long term, inexorably increase the country's carbon emissions far into the future.

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1. The total capacity of installed wind and solar power plants in 2019–2020 was 3,016 MW, which represents a 340 per cent increase from 2015–2016.

THE LINKS BETWEEN URBAN SPRAWL AND GREENHOUSE GAS EMISSIONS

Urban sprawl is more than simply low densities of habitation, although very low residential densities in a city or parts of a city are probably the single most direct measures of it. Urban sprawl also relates to fragmentation, dispersal and discontinuities in the whole built environment, to longer distances and travel trajectories and to the resulting dependency on the private car and the inefficiency of public transport.

The literature on urban sprawl has so far mostly been directed at the phenomenon as found in Western countries, especially in the last fifteen years, as the issue of global warming has increasingly preoccupied scientists and urbanists. A good summary of the issues involved can be found in the 2018 OECD publication *Rethinking Urban Sprawl* (OECD 2018). This study notes that in most OECD cities, low-density urban areas have been increasing significantly in size since 1990, especially on suburban fringes of both metropolises and smaller towns. The OECD study links these trends directly to more traffic jams (and time costs), more GHG emissions, more air pollution, larger infrastructure investments and higher recurrent costs per user. The study identifies a number of contributing factors:

- Low average residential density, especially the percentage of a city's population residing in very low-density areas (under fifteen individuals per hectare).
- Fragmented and discontinuous built environments, especially spatial segregation of land uses and a high number of large open areas.
- Many and dispersed 'high-density' multifunction concentrations or peaks.
- Lack of grid and supergrid primacy and lack of high-density corridors.
- Overuse of cul-de-sacs and gated communities.
- Excessive use of limited-access highways and high-speed interchanges.

For the Western cities studied, the report strongly links these factors to increasing carbon emissions, which are mainly due to the fact that a sprawling, disconnected and dispersed built environment makes

for longer average distances travelled and ever more personal vehicle usage. Not only are private means of conveyance comfortable and convenient in suburban environments, they are often the only such means available. And without exorbitant and endless public subsidies, it will be almost impossible to provide anything like convenient, frequent and low-cost public transportation systems as an alternative to these sprawling areas. In addition, there is, it seems, a reinforcing trend: as sprawling and low-density urban landscapes make the private car unavoidable, ever more space must be devoted to this private transportation (residential and commercial parking, service areas, drive-through commerce, etc.), and this further decreases densities of urban habitation and locks in these factors for the far future.

What are the means of combating urban sprawl and its negative effects? Such urban sprawl, once in place, is extremely difficult to correct. However, in the long term there are a number of measures – mainly dealing with land-use planning and taxation – that can be used (see OECD 2018, 12–13; UN-Habitat 2011, Chapter 5):

- Relax maximum-density restrictions and avoid single-lot housing units.
- Reform property and land-use taxation in order to discourage large land parcels.
- Shift the cost of infrastructure on to developers.
- Introduce road-pricing mechanisms.
- Introduce/increase parking charges.
- Raise motor fuel taxes.
- Invest heavily in public transport.
- Retrofit buildings and encourage infill.

These measures have had some success in containing or attenuating urban sprawl, especially in European cities where there is already strong community resistance to air pollution and the continuing destruction of natural habitats. Yet they are often opposed by private car owners and suburban residents, who can create very strong interest groups at the municipal level to lobby for preserving low densities and associated privileges. In other words, the struggle against urban sprawl is a difficult one politically and can have noticeable effects on reducing GHG emissions only over the very long term.

EGYPT AND GREENHOUSE GAS EMISSIONS

Egypt, as a lower-middle income country with a nominal GDP per capita of USD 3,500 in 2020, is not a large contributor to GHG emissions in per capita terms, at least when compared to Western countries or the Gulf States. However, Egypt has seen a sustained rise in its GHG emissions, mainly in the electricity and transportation sectors of the economy. Between 1971 and 2020, the country's CO_2 emissions increased twelvefold (from 25 to 269.5 million tons), going up 6 per cent per year over the 2011–2016 period and doubling between 2002 and 2017. These increases are caused in large part by the transportation sector (gasoline consumption increased 7 per cent annually in 2011–2016.) And when looking at the country's very low rate of private vehicle ownership (only 15 per cent of families have cars in urban areas), it is inevitable that this rate will increase with economic growth and that the upward trajectory of CO_2 emissions will become more acute.

The Egyptian government is very aware of the transportation sector's contribution to rapid increases in GHG emissions. According to Egypt's report to the UNFCC titled *First Updated Nationally Determined Contributions* (UNFCCC 2022), under a 'business as usual' scenario, the transportation sector's production of GHGs is expected to jump from 48,235 $GgCO_2$ in 2015 to 124,300 $GgCO_2$ in 2030, representing a colossal annual increase of over 10.5 per cent. This rate of increase far outstrips the expected rates of growth of GHG emissions from the electricity and other sectors. And whereas Egypt hopes to achieve considerable mitigation of total GHG contributions over the same period (a 33 per cent reduction in the electricity sector and a 65 per cent reduction in the oil and gas sector), hopes for CO_2 mitigation from the transportation sector are much more modest, at only 7 per cent by 2030. This modest mitigation will largely be because of an expansion of the metro and electrified rail networks in Egypt during the 2015–2030 period and the removal of subsidies on vehicle fuels. In other words, the government is aware of the serious problems that its transportation sector represents when it comes to the country's contributions to GHG emissions.

GREATER CAIRO'S URBAN SPRAWL AND GHG EMISSIONS

The Greater Cairo Region (GCR) – made up of the Cairo Governorate and parts of the Giza and Qalyubia Governorates – had a population of 20.2 million in 2017, representing about 23 per cent of the nation's total. However, the GCR contributes at least 40 per cent of national transportation emissions (45 million tons CO_2 equivalent) and contains over 50 per cent of all motorized vehicles in Egypt (the number of which is increasing at a rate of at least 3.6 per cent per annum) (Abbass, Kumar and El-Gendy 2021, 285).

In the last two decades, the GCR has received a certain interest in problems of traffic congestion, air pollution and poor public transportation and their social and economic costs (World Bank 2013). More recently, the World Bank's Greater Cairo Air Pollution Management and Climate Change Project has been supporting Egypt's efforts to reduce both air pollution and climate pollutant emissions, in line with the country's Sustainable Development Strategy (as contained in Egypt Vision 2030, see World Bank 2020). The main policies being supported include improving Egypt's air quality management system, improving solid waste management in the GCR, supporting the introduction of electric buses and encouraging behavioural changes by communities and service providers as they relate to surface transport. However, the project does not include the promotion of any policies that could mitigate GHG emissions in the GCR caused by massive urban sprawl in desert new cities; this peripheral urban sprawl is not even mentioned as constituting a fundamental contributor to carbon emissions.

A similar ignorance of sprawling urban development around Cairo can be found in what little literature exists on urban sprawl and the GCR. A quick Google search reveals that almost all academics and commentators who take up this issue restrict themselves to deploring informal or unplanned development, mainly on agricultural lands. This is ironic, since such unplanned development has, over 60 years, taken up only some 180 square kilometres (only a fourth of the area of Cairo proper and less than 7 per cent of the GCR's 2019 urban footprint), and yet it currently houses over 60 per cent of the metropolis's population. Such 'unplanned' development produces an extremely dense and compact urban fabric, hardly the kind of urban sprawl that the OECD and UN-Habitat, among others, describe. Yet,

as is frequently the case in Egypt, informal settlements are blamed for a whole range of economic and social ills.

It is undeniable that the GCR *has* experienced extremely extensive urban sprawl. This sprawl is massive, accelerating and, remarkably, all planned. It has produced and is still producing urban patterns that are most strongly related to increased GHG emissions (as enumerated in the OECD report mentioned above). But for some reason, such desert sprawl has been given little attention, probably because it is planned and has been sanctioned by the state as part of the government's national new towns programme. This new towns programme, which was launched in the late 1970s, has already established some forty-five new towns throughout the country, and many more are on the drawing boards. Eight of these new towns have been set up around Cairo (Tenth of Ramadan, Sixth of October, Fifteenth of May, El Obour, Sheikh Zayed, El Shorouk, El Badr and New Cairo), and most of these new towns have had their boundaries extended several times.

All these new developments around Cairo rely on the continued availability of empty tracts of public land. While in theory having ample empty public land available is an enviable situation that many metropolitan areas worldwide wish they found themselves in, in the GCR the exploitation of this resource over the decades has relied on the misguided belief that modern, high-standard, low-density, sprawling, car-oriented developments operating under top-down bureaucratic dirigisme would quickly create jobs, absorb the increasing metropolitan population and provide an attractive alternative to informal settlements. That this was not happening was already apparent in the 1990s, but the same policies have continued and even accelerated in the last twenty-five years, with more and more desert tracts designated for new-town expansion. The government's announcement in 2015 that it would create a new administrative capital (NAC) east of Cairo on a huge 700 km^2 tract of land represents the most extreme example of these policies.

The new towns around Cairo have been very successful in attracting modern commercial, entertainment, business, educational and medical activities, and these have become scattered rather randomly throughout new-town landscapes. However, there has been a near complete failure to create communities and economies in which

the mass of the metropolitan population could thrive (Sims 2012). Instead, most residential development has been targeted at Cairo's middle and upper classes (and the speculative real estate investment that goes along with this kind of development). This trend has become even more pronounced with the launch of the NAC in 2015. In effect, it has been difficult for the new towns around Cairo to attract even a small fraction of their intended population. According to the 2017 census, the eight new towns around Cairo had a combined population of just 1.3 million, only a paltry 6.4 per cent of that of the GCR. Census figures also show that the GCR's population increased by 4.9 million from 2006 to 2017, while the new towns around Cairo absorbed only 14 per cent of this figure, with the rest absorbed by Cairo proper, mostly in informal settlements.

The spatial configuration of the new towns around Cairo (including the NAC) is characterized by discontinuous built environments, segregation of land uses and numerous large open areas and wide traffic corridors. Dispersed high-density multifunction concentrations or islands are very common. Cul-de-sacs, mono-use enclaves and excessive limited-access highways and high-speed interchanges are the main vocabularies of urban design norms. These norms may be attractive to the car-oriented middle classes and allow for comfortable individual lifestyles, but taken together they demand mobility systems that inherently contribute greatly to GHG emissions and air pollution.

These sprawling desert developments around Cairo are slowly being populated by car-owning segments of the GCR's population; those who are relatively well-off. And travel from elsewhere in the GCR to the many commercial, industrial, service and entertainment attractions found in the new towns also requires, in most cases, the use of private vehicles over very long distances. Consequently, not only are these new towns not inclusive; their spatial layouts also generate transportation patterns that can only greatly increase carbon emissions.

CURRENT SPRAWL AND RESIDENTIAL DENSITIES IN THE GCR

The most direct way to describe the dynamics of urban sprawl is to look at the composition of metropolitan population densities. This was done for the year 2017, and projections were made for the year 2027 (see Tables 1 and 2).

Table 1. Greater Cairo Region 2017

	Gross area	Population	Density (pop./km²)
Cairo proper	610 km²	18.6 million	30,491
Authorized new areas	1,880 km²	1.63 million	867

Sources: census, Google Earth, and New Urban Communities Authority (NUCA) documentation.

Table 2. Projected Greater Cairo Region 2027

	Gross area	Population	Density (pop./km²)
Cairo proper	650 km²	24.1 million	37,070
Authorized new areas	3,810 km² (including the NAC)	3.2 million	840

Sources: census projections, Google Earth, and NUCA documentation.

Note 1: 'Cairo proper' is all of the historical metropolis as it has expanded contiguously on both sides of the Nile (see Figure 1).

Note 2: 'Authorized new areas' are mostly the eight new towns around Cairo, including their formal extensions. Overall, as of 2017 perhaps a third of these new areas were already built-up and mature, although development is rarely complete and urban landscapes still show patchy spatial patterns, with undeveloped parcels sprinkled throughout. Another third of these authorized new areas is made up of plots that have been sold to developers or allocated to state agencies. On these lots, a few projects have completed their first phases and ground has been broken for most of the rest (see Figure 1) Finally, in the remaining third of these areas, vacant superblocks are still being allocated/sold, and off-site infrastructure is being installed.

Overall, as can be seen in Table 1, Cairo proper – where almost everyone lives – had a gross area of 610 square kilometres in 2017, with a population of 18.6 million and a high average residential density of 30,491 people per square kilometre (305 per hectare). In contrast, the GCR's authorized desert development extended over an enormous 1,880 square kilometres, three times the area of Cairo proper, but had a population of only one-twelfth of that of Cairo proper and a very low density of only 8.7 people per hectare.

By 2027 (see Table 2), it is expected that Cairo proper will have expanded very modestly to 650 square kilometres but will have

absorbed most of the population growth over the preceding ten years (an additional 5.5 million people). In contrast, authorized new areas by 2027 will have expanded dramatically to 3,810 square kilometres, more than doubling in size. The residential population of these areas will also have almost doubled (an additional 1.6 million). The result will be that average residential densities in the new desert areas will actually have slightly decreased, from 857 people per square kilometre to 840 people per square kilometre. In other words, the already huge imbalance between core and periphery densities in the GCR is expected to be maintained and even increase.

This dualism in the GCR's make-up is visualized in Figure 1. The sharp contrast between Cairo proper and the sprawling urban landscapes to the east and west is very apparent. And, as can be seen, yet more new town extensions and new projects are likely to be added to the far desert fringes. Figure 1 shows that there are major limited-access highways (ring roads and regional arteries that were finished in 2021) which will, inevitably, open up more, very far-flung virgin desert land for all kinds of sprawling and disjointed development.

The low density and disjointed nature of peripheral development in the GCR can be highlighted by looking at the particular development of the eastern desert quadrant. This contiguous area, extending over 2,100 square kilometres (see Figure 1), is twice the size of the city of Los Angeles and also twice that of New York City. It contains the new towns of El Badr, El Obour, Tenth of Ramadan, New Cairo and El Shorouk, plus the NAC. But it also contains other developments, in particular the new Ministry of Defence, Future City, El Heikastep compound, New Heliopolis and the Robiki industrial complexes. And more schemes are being added to the south and east.

GCR SPRAWL AND THE PROBLEM OF PUBLIC TRANSPORT

In the decades of sparse and sprawling development in the new towns around Cairo, public transportation has been a neglected factor. Until recently, there were only very few and infrequent Cairo Transportation Authority (CTA) bus services out to the new towns (leaving informal minibus systems and tuk-tuks to meet demand). Thus, transportation has been a serious problem for carless families who might choose to live in one of the new towns (in fact, poor transportation services have

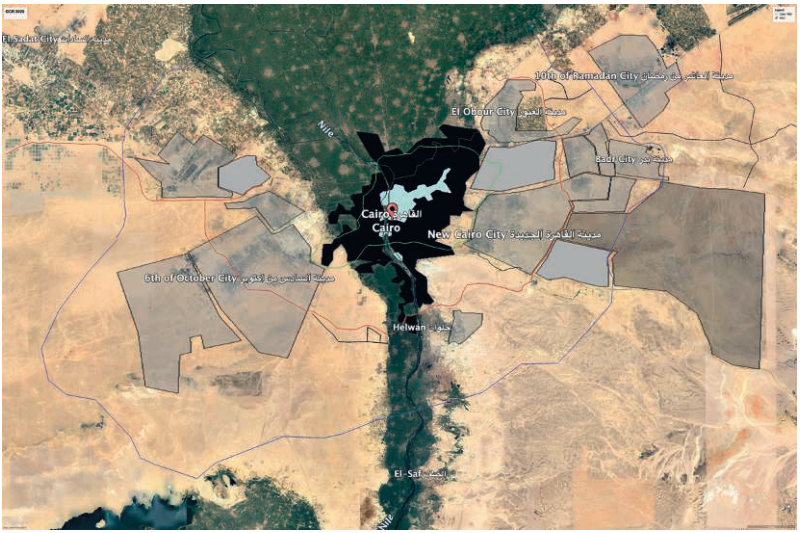

Figure 1. Greater Cairo with urban extensions and highways (Cairo proper in black; 1952 Cairo in light blue).

for years been identified as one of the major obstacles to the development of Cairo's new towns). With the exception of Fifteenth of May and, to a lesser extent, El Obour, all new towns around Cairo are tens of kilometres away from the city's central areas or from any other large urban agglomerations. However, in 2016, the government announced the construction of a light-rail line with twelve stops that would link to the metro's Third Line, serve the GCR's eastern desert cities and terminate at the NAC. This line was inaugurated in July 2022. An ambitious monorail system is also under construction to link the NAC to Nasr City in the east quadrant and Sixth of October to Giza City in the west quadrant. These two projects represent a quantum leap for public transportation to Cairo's new towns, but it remains to be seen how many people who own cars will choose to ride these new systems.

Even if these public transportation lines will attract a large ridership (which some experts question due to fare prices, frequency, and access issues), movement *within* the new towns is and will remain an intractable problem. The issue is, again, space and distance. The new towns are planned on such huge scales and exhibit such low densities that it is hard to see how public bus networks could be made

to function and provide frequent, convenient services from one neighbourhood to another without requiring huge subsidies. And it is unlikely that those with private vehicles will shift to these public transportation networks for in-town journeys. In fact, this is the main issue with both the light-rail and the monorail systems: how to get to and from the various stations, all of which are located far from residential areas and most of which are also far away from commercial and service establishments. In other words, the 'last mile' (or rather the last five to ten kilometres) is the crucial issue for public transportation in the new towns, This issue, in a sparse, low-density landscape that is already full of private car users, will remain the main challenge.

SUMMING UP: A GHG-HEAVY FUTURE FOR THE GCR

It should be clear that the ways the new towns around Cairo have been designed and have expanded during the last fifty years have created an enormous and discontinuous urban sprawl that guarantees the primacy of individual personal transportation and locks in the generation of large and increasing quantities of GHGs. And there is every indication that the processes that created this sprawl are set to continue unabated.

It is difficult to see how such a depressing future can be avoided. Tinkering on the margins – more electric rail lines, more park-and-ride facilities, more shuttle buses on main corridors and more promotion of carbonless last-mile solutions – might help. But the task is overwhelming, given the structural conditions and the existing momentum for yet more sprawl. And unfortunately, the government does not yet have a policy to reduce private car usage in the GCR. Raising awareness among both citizens and decision makers might help if it were possible to demonstrate that continuing such sprawl policies will slow Egypt's economic growth as well as compromise the country's sustainable development.

One might ask, does Egypt not have the right to create the same extravagant urban sprawl as has occurred in the West? After all, it is not Egypt that has contributed to the current global climate crisis. This is very true, but even if it were possible to ignore GHG increases, Egypt will still suffer from the high costs of urban sprawl – in terms of the unsustainable rise in fossil fuel consumption, increased traffic congestion, increased infrastructure costs and the drain on state budgets implied by such a car-oriented urban future.

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PASCAL MENORET*

THE PETROPTIMIST:
DANCING IN THE RUINS OF FOSSIL CAPITALISM

Cars have done more to damage our cities than wars.
—J. H. Crawford, *Carfree Cities*

SAUDI CARS AND THE ECOLOGICAL CRISIS

What can we learn from Riyadh that might reduce our dependency on the car?[1] We know that cars contribute a great deal to the current ecological crisis. This crisis is a consequence of what some authors call the Anthropocene while others, pointing to the specific responsibilities of capitalism, colonialism and imperialism, use the terms Capitalocene, Plantationocene or Secularocene to describe the ecological violence that surrounds our species (Haraway 2015; Malm 2016; Meziane 2021).

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Cars have been at the centre of capitalism and colonial expansion for around a century (Clarsen and Veracini 2012). Their ecological impact is not only the result of car production, maintenance, emissions and disposal but also of the 'vast infrastructure of oil terminals, petroleum refineries, asphalt plants, road networks, gasoline stations – not to speak of the film industry, the lobbying groups, the billboard' (Malm 2016, 7). This infrastructure of automobility both allows for car supremacy and is enabled by it: it is self-reproducing and self-expanding (Urry 2004). In Saudi Arabia, transportation represents about 26 per cent of all greenhouse gas (GHG) emissions and is the sector that contributes the most to emissions after electricity production. Private cars spew out a big chunk of these emissions, and they are still the main way to get around in a country with extremely high urbanization rates, sprawling urban areas, cheap fuel, limited public transit options and a harsh climate (Rahman et al. 2017, 815–87). In 2016, World Health Organization data showed that Riyadh was the fourth most polluted city in the world when it comes to fine particles ($PM_{2.5}$, or particles with a diameter of 2.5 micrograms or less). At 156 micrograms per cubic metre, Riyadh exhibited higher $PM_{2.5}$ concentrations than either Delhi (122), Beijing (85) or Cairo (76), a far cry from the World Health Organization's recommended maximum level of 10 micrograms per cubic metre (*Guardian* 2017).

This dire situation is in large part the result of urban planning decisions made during the past century. Riyadh developed from the 1930s onward along avenues that radiated from the old city toward the north, where the king and his family built their residences and to where the state bureaucracy moved from coastal Jeddah in the 1950s. In contrast to this relatively dense and compact city, the master plan for Riyadh proposed by Greek architect Constantinos A. Doxiadis was based on the idea of a car-centric linear city. Released in 1971, his plan was a grid of highways linking up superblocks that would become suburban communities. In the 1970s, the capital went on a spree of sprawl, a movement fuelled and amplified by the 1973 and 1979 oil booms. Growth was so fast that the Doxiadis plan was obsolete by the end of the decade and another urban planner, French public agency SCET-I (Société Centrale pour l'Équipement du Territoire - International), designed a second master plan. This new

plan created a ring-road around the city and expanded Doxiadis's car-based grid of superblocks to officialize galloping developments (al-Hathloul 2017).

The Riyadh of today is marked by low density, vast suburban tracts along large freeways, a plurality of city centres serving different communities and massive public investments in road infrastructure. By the late 1990s, cars were used for about 98 per cent of daily trips in the capital according to the Riyadh Development Authority, the public entity Prince Salman bin 'Abd al-'Aziz created in the 1970s to iron out the difficulties arising from the Doxiadis master plan (Riyadh Development Authority 2001, 3–11). In view of increased congestion and pollution and a rise in GHG emissions, the Saudi state started planning a subway and bus network for the capital in the early 2010s. At the time of writing, it has yet to be opened.

A slew of recent studies looked at what impact public transit might have on Riyadh's low-density, sprawling urban environment. Their conclusions are sobering. First, the future availability of public transit is unlikely to convince drivers to leave their cars at home unless a series of policies – including fuel, congestion and parking pricing – compel them to do so. 'Currently, there are no significant policy interventions to discourage the use of passenger cars in Saudi Arabia', the authors of a study on road transportation conclude (Rahman et al. 2017, 820). Second, drivers would be ready to use public transit if Riyadh were more walkable. According to a 2021 study, public transit ridership would soar by 22 per cent if walking time to metro stations were reduced to five minutes (Youssef, Alshuwaikhat, and Reza 2021). The dominance of individual housing, the long distances and the climate make that goal impossible to reach in the current conditions. Third, Saudi citizens, who make up two-thirds of Riyadh's population, are more likely to drive than to ride public transit. In one study, citizenship is the main predictor of an individual choosing a personal car over collective transportation (Youssef, Alshuwaikhat, and Reza 2021). This suggests the emergence of a petrocitizenship model, whereby the car is a vehicle for belonging and exclusiveness and driving is linked with national identity.

MODERNIST PAST AND LA LA LAND FUTURE

In view of this ominous situation, as Riyadh is growing fast and does not seem to reduce its dependency on the automobile, what can we learn from the city? As Arabian Peninsula cities are becoming urban models in the Middle Eastern region, with their economies based on low density, car transit and massive government and private debt, how can the example of Riyadh enlighten us at a time of accelerating climate change and ecological disaster?

Because of its quintessential mid-century modernist quality, its low-density, car-based landscape and its record pollution levels, Riyadh might paradoxically be one of the best candidates for any study on how to retrofit suburbia. It is precisely because it presents an extreme example of sprawl that the questions of its walkability, sustainability and transit system might lead to convincing answers about how to deal, worldwide, with the city the car created. This example par excellence of petro-urbanism could become a laboratory for the post-oil city.

Where might change come from? The transportation engineering literature is unanimous: top-down plans to reduce car dependency might look as good on paper as Doxiadis's master plan, but recent history and the careful survey of individual preferences suggest that they might fail to enact change. The questions the current state of the city poses are nagging: how might public transit actually replace private cars? How can dwelling practices eschew a real estate market that pushes the city limits outwards and leads to more sprawl, less density and less accessibility?

One way to look at the question of urban sprawl is to dwell in the present moment, to contemplate the dystopia of the car-based city precisely when it seems to be bursting at the seams. Between Doxiadis's modernist past and the 'La La Land' future of net-zero carbon emissions – to use a recent quote by the Saudi energy minister (*Saudi Gazette* 2021) – there is a painful present, made of soaring emissions, ecological destruction and widespread pollution. It would be easy to dismiss the current moment as failed and to profess a complete form of petropessimism, but I want to analyse some of the most curious forms of social life that the present harbours and embrace the peculiar kind of optimism that Riyadh-as-dystopia embodies. What might we learn, then, from Riyadh's 'quiet encroachment of the ordinary' (Bayat

1997) that could help us understand how to reform a heavily top-down, planned community? What does Riyadh teach us about how to deal with other planned communities and car-based cities?

NO OIL DETERMINISM

Planners and transit engineers now agree that the city's lack of density constitutes the main obstacle to energy-efficient, ecologically sound retrofitting. How is that far-flungness treated by planners, decision makers, builders and residents? There are four lessons that one might learn from Riyadh's empty spaces.

The first lesson Riyadh could impart is that there is no such thing as oil determinism and that petro-urbanism is political through and through. In the north of the city, new blocks quickly emerge from the desert, and emptiness is converted into suburban tracts along desert freeways and spotless curbs. If nature abhors a vacuum, developers delight in the void: Riyadh consistently grew beyond the limits posed by planners and the municipality. From the mid-1980s onwards, the Saudi state, worried about haphazard growth, created a policy of 'urban growth boundaries': the state decided not to create public infrastructure outside a certain limit. This did nothing to stop growth: while seemingly putting an end to sprawl, this policy in reality enshrined the power of the developer as a city builder and infrastructure provider. To build outside of municipal boundaries, developers were required to create the roads, electricity networks and street lights that the state provided elsewhere. The city would ultimately legalize these de facto informal developments once the infrastructure had been built and the appropriate strings had been pulled. Riyadh's fastest developments thus occurred beyond its municipal boundaries, i.e. outside of the area where it was legal to build and where the municipality provided publicly funded infrastructure (Bonnenfant 2014; Menoret 2014; al-Hathloul 2017).

It would be easy to read Riyadh's flat, car-based landscape as an outcome of oil determinism and to simply blame it on the curse of the black gold. But this landscape emerged out of a series of political decisions, starting with the original willingness to grant developers a large measure of autonomy, to give them carte blanche to create housing and shape the city. By doing so, the state privatized the city's infrastructure, and developers, with all their demiurgic powers,

emerged as crucial political figures and major power brokers. What we may call an oilscape or petroscape is in reality a political landscape – the void is political.

VOID IS COUNTER-INSURGENCY

The second lesson is that low density is an urban counter-insurgency measure. The ecological crisis is a power crisis: it is the product of an immense and oppressive accumulation of power into few hands. How does the politics of the void work at the micro-level? The project to de-densify the city and radically change its face is encapsulated in one page of Doxiadis's report on existing conditions in Riyadh (Figure 1). It shows two maps, side by side, under the title 'Comparison Among Various Urban Patterns' (Constantinos A. Doxiadis Archives 1968, 275). On the left, a map of 'Traditional Riyadh' shows the 'dominance of solid mass'. The old city is jam-packed, and solids – houses, mosques, palaces and shops – dominate the landscape. Voids are few and far between: they are the narrow lanes that crisscross the city, the small squares that connect them and, inside homes, mosques and palaces, the 'patios' or courtyards that are open to the sky. On the right, a map of a 'modern North European suburb' shows, by contrast, the 'dominance of void'. Free-standing buildings are lost in a vast empty space through which runs a road. The scale is the same, but instead of the dozens of buildings that this segment of old Riyadh accommodates, this fraction of a 'North European suburb' contains exactly seven houses. Emptiness separates families in space, renders them visible and accountable and provides fast transportation to all, including the state.

Constantinos A. Doxiadis was the master planner of Islamabad and Baghdad; Saudi decision makers called on him to organize urban growth in the mid-1960s, as they were wary of worker and student unrest. The radical 1960s in Saudi Arabia were marked by strikes at the US-owned and -operated oil company Aramco, by socialist and nationalist activism, by a vast student movement and by massive rural migration. The hinterland was coming to the city, and the 'mettlesome masses' celebrated by Frantz Fanon (1963, 127) were moving to the foreground, triggering a form of slum anxiety among decision makers. Slum removal became the rule of the urbanist's game.

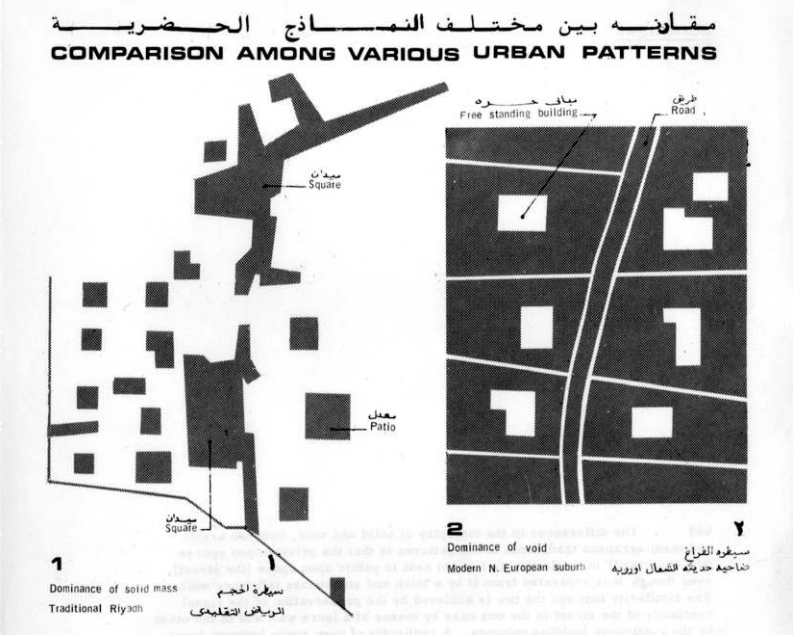

Figure 1. Riyadh and the 'Northern European suburb'. Source: © Constantinos and Emma Doxiadis Foundation, fig. 2 from DOXS-SAU-A 2, July 1968, Saudi Arabia vol. 1 (File 23305).

Ever the architect, Doxiadis offered a simple solution: turning housing inside out like a glove to remove the void from within the home (the courtyard) and to project it around villas like a buffer (the front yard and backyard). By doing so, Doxiadis was abolishing the various forms of collective dwelling that existed in the old city to consecrate the domination of individual housing, thus transforming a dense city into a sprawling suburb. The outcome was population dispersal, and – ideally – each Saudi (male and adult) citizen was meant to become a landowner and a king in his own castle. Riyadh was to be modelled after the 'Northern European suburb', a capacious fiction that Doxiadis might have snatched from his visits to the United States, where he also worked in city planning in a context of increased racial and residential segregation. The city of solid forms was now dominated by the void.

What psychological and socio-political effects arise when residents move from ancient courtyard homes in a dense inner city to vast suburban villas surrounded by an empty walled enclosure? This question is explored in several Saudi political novels, including Muhammad al-Muzaini's *Mafariq al-ʿatama* (Al-Muzaini 2004), which links the emergence of a powerful Islamic movement, *al-sahwa al-islamiyya* (Islamic awakening), to the sprawling emptiness that surrounded the old city after the master plan's implementation in the 1980s. Islamic activists re-enchanted the void; they organized in the interstices of a space whose main quality was its in-betweenness. Al-Muzaini's materialist genealogy of religious activism, at the antipode of mainstream Orientalism, points at the agency of space and at the counter-power of everyday, grassroots activism. It is also a brilliant analysis of the culture of visibility and invisibility, of careful publicity and overwhelming privacy, that comes with suburbanization. Privacy, *khususiyya*, became a political object; it was addressed by urban planners and architects who sought to protect the privacy of the houses and communities they were building. It was also addressed by state elites, who turned privacy into one of the credos of Saudi nationalism: there was a Saudi national privacy, a Saudi exception that had to be defended against outside forces.

What kind of agency does the void possess? How do empty spaces influence everyday decisions, economic prospects and political activism? Looking at voids in the urban fabric, at spaces that have been forcefully emptied and turned into blank spots, is an invitation to ponder on what it means to dwell, to be removed, to use or misuse land. Neighbourhoods of Riyadh are continuously remodelled, emptied and turned into more legal, less informal formations. Al-Mursalat, in the north of Riyadh, was home to an informal community until the 2010s. Working-class residents had built their homes there, independent of any formal process, in the 1970s. The community was displaced and the neighbourhood razed in the mid-2010s: formalization asserted itself as a process of destruction and removal (Khayf et al. 2018). The same dynamics is currently observable in al-Shumaisi, a much older neighbourhood southwest of the old city, where block after block is being erased from the map and where it is unclear what will succeed the organic city of the 1930s and 1940s (Alsulaym and Alzamil 2021). The suburb and the car are counter-insurgency instruments

and disciplining mechanisms; their ecological footprint is irrelevant to the systems of power that have been patiently emerging between refineries, gas stations, freeways, air conditioning units, desalinated tap water and the suburban dream's discrete enclosures.

THE MASTER PLAN IS THE MONUMENT

Riyadh's third lesson is that it never really grew out of modernism, if we define modernism as the creation of an abstract space, a disciplinary space, a space of consumption, a measurable and controllable entity that replaced lived environments and organically inhabited places – a technosphere that brutally negates and opposes the biosphere. Historians sometimes complain that Riyadh is a city without monuments; a city whose monuments – the grand mosque, the city walls, the old city in its entirety – have been demolished. This is of course true, but the master plan and its careful orchestration of voids and solids may also be seen as the main monument of the city, as the monument of an age of triumphant, toxic technological modernity – as a monument to fossil capitalism.

The master plan turned emptiness and destruction into urban forms. It was artificially and forcefully imposed on a variety of minutely, organically designed environments, from al-Dira to al-Shumaisi to King Fahd, in a process of monumentalization. Master plans are made tangible by a process of carving out and of evisceration. They exist through the active ignorance of planners, who in the case of Riyadh came from outside, from Greece and France, and had a hard time understanding the environment they were called on to shape. The master plan of Riyadh is an Orientalist fantasy superimposed on a living city by an ambitious planner who sought to create an Islamic city of future, a city whose east–west freeways aligned with the direction of Mecca; a praying city, a mosque of a city (Menoret 2014, 98). In the meantime, the destruction of informal areas led to population displacement: roughly one-fifth of the city's population was forcibly removed to the periphery of the city in 1968, towards such working-class suburbs as Hayy al-Dakhl al-Mahdud ('low-income neighbourhood') or al-Nassim ('the breeze'). The Islamic city of the future was underpinned by demolitions and deportations. The ecological crisis was prefaced by organized violence against the poor.

As noted, Riyadh's second master plan, designed by French public operator SCET-I, merely legalized the haphazard sprawl of the city, which boomed thanks to the 1970s oil bonanza. The SCET-I master plan confirmed the process by which developers had become de facto planners and enshrined the displacement of populations. Voids were easy to police and open to investment. Their mere existence authorized the creation of a vast network of freeways, hooking households to oil as the main driver of the economy and the main way of powering transportation through the city. In this period, driving – which until 2018 was a male privilege – started to define the Saudi national identity. The ban on women driving enabled the state to further penetrate the private sphere by forcing families to constantly create new strategies to bridge the distances and voids that daily life entailed. Fossil urbanism redefined the family itself and buttressed patriarchy.

THE PETROPTIMISTS: JOYRIDERS AND ACTIVISTS

The fourth and last lesson we might learn from Riyadh is that disciplinary spaces are not subversion-free. This is where petroptimism lies: going against the idea that oil is an incapacitating curse and that all is already lost, this neologism is inspired by the contradictory figure of Emile Habiby's pessoptimist, caught between the violence of Israeli colonialism and the hopes created by Palestinian resistance (Habiby 1985, xi–xiv). The pessoptimist giddily walks through a lost landscape and in so doing demonstrates Palestinian creativity and resistance to oppression. The notion of petroptimism similarly denotes the ability of everyday actors to turn oilscapes into spaces of activism, expression and resistance, despite these spaces' apparent determinism and the violence that is unleashed in them. To speak of petroptimism neither invalidates the anxieties one might have about the domination of cars in cities nor does it preclude research into the future of the oil city. However, it invites us to pay attention to what happens in the interstices of the modernist project and to follow the trajectories of those unsung antiheroes who grew up in, organized and silently or vocally deprogrammed the fossil infrastructure of the modern city. Theirs was sometimes a foolish project, one that was ultimately met with repression and erasure, but the figures of the joyrider and of the Islamic activist opened spaces of creativity and freedom that contributed to subverting the modernist project.

Joyriders have raced cars on Riyadh's avenues and freeways since at least the 1980s. They hacked the road infrastructure of surveillance and profit and turned internal combustion engine vehicles against themselves. Extreme speed, daring figures and the misuse of roads and cars creatively unmake the city. Joyriding happens in the voids around and within the city, in both the new tracts that are under development (and are not yet policed) and on the massive freeways that cut through the city. Joyriders deliberately misuse the spaces created by developers and engineers. From the void of the modernist city they create an action-packed, highly octane spacetime in which they strive to escape the traffic police by being more daring and faster, organizing better and being better drivers (Menoret 2014). As a spectre that haunts Saudi suburbia, they re-politicize the void and question the very movement of sprawling expansion that generated the car-based city. The peculiar form of accident porn that is exhibited in YouTube videos, showing severed limbs flying out of crashing cars, is a morbid metaphor of the ecological disaster that automobiles are meting out to species and ecosystems.

Since the 1970s, religious activists have also re-politicized sprawling communities by organizing in the typically suburban institutions of the mosque, the school and the summer camp. They turned even the commute – this quintessential suburban rite – into an activist resource. Instead of discarding commute time as empty and depressing or as representing the epitome of individualization and atomization, activists embraced the peculiar spacetime of suburbia. To them, the commute was not lost time but time regained through the utilization of cars as vectors of contention. In Saudi Islamic movements, the car, *al-sayyara*, is the smallest unit and replaces the family, *al-usra*, which elsewhere names the smallest unit of a religious group. Activists also invested in the free time of recesses and holidays, extracurricular activities and summer camps; all spacetimes, once left empty, became resources for organizing. Summer camps in particular provided Islamic activists with a potent political model. When the state allowed limited municipal elections in the 2000s, many Islamic candidates used this activist know-how to organize their electoral campaigns on the tried model of the suburban summer camp. Thanks to their organizational experience, Islamic activists obtained all seats of the Riyadh municipal council in 2005, thus demonstrating both the prominence of the Islamic movement in the

political sphere and the active politicization of voids and empty spaces (Menoret 2020). Activists often beat powerful developers in the voting booths: the architects of ecological disaster were left in the dust by grassroots activists who promoted public engagement and debate, including on broader urban ecological issues. Their efforts were short-lived, however. Saudi municipal councils were ultimately not independent and did little to undo the car city that the central state had created.

CONCLUSION

Was slum anxiety unfounded? Was it silly to believe, as modernist planners and their patrons did, that urban density would bring about political challenges? Probably not. But slum anxiety could have been complemented with a dose of suburban anxiety, too. Urban sprawl and empty spaces, which political and economic elites developed to keep a measure of political and financial order, could also become subversive resources. Through their active exploitation of various petroscapes, Saudi joyriders and religious activists wittingly or unwittingly responded to a pressing question: how might we imagine life in the ruins of petrocapitalism and of the Capitalocene/Plantationocene, in the ruins left behind by the destruction wrought by urban demolition, population dispersal, political repression, economic violence and ecological disaster (Tsing 2015)? The global economy is predicated on the fiction of infinite growth, which itself is based on the fiction of a cheap supply of fossil fuels. While contemplating the Anthropocene, Capitalocene, Plantationocene or Secularocene, it is easy to allow oneself to become pessimistic and read in the petroscapes that surround us, and that we often co-produce, only the collapse of ecosystems and the end of the global economic system. It is easy to forget that the fossil apocalypse is not a future event: it already happened in Saudi Arabia and elsewhere, and this continuous emergence requires from us acute attention to the present and to its creative potentialities. Hence the figure of the petroptimists, their feet stuck in bitumen and their eyes looking at the stars, who through everyday acts of bricolage and subversion invent a present in which grassroots organization might be possible. The petroptimists do not let themselves be intimidated by the modernist past, despite the oilscapes that we inherited from that period. They do not let themselves be fooled by 'environmental messages' about the future of the planet,

which 'are acceptable when they are controlled and shaped by petroinvested governments, industry organizations, and corporations' (Wilson 2014, 245). Between the past and the future, petroptimists carve a creative, activist, open-ended present. The ecological crisis might mean our impending death, but those who lived and organized through the apocalypse are now playing in the ruins.

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AHMED ZAAZAA*

THE EXTRACTIVE SECTOR: REAL ESTATE URBANISM IN GREATER CAIRO AND ITS TOLL ON THE ENVIRONMENT

A GLOBAL TREND

Climate change compounds existing vulnerabilities that are produced by a continual interaction of political, economic and social processes (Hassanain and Martina 2021). The forces of capital constantly reconfigure city spaces to maximize the value of assets and resources. The conversion of city spaces into separate archipelagos for investment – rather than parts of a social and natural ecosystem – forces the city's users to accept the production of an urbanization surplus, which expands the city massively and increases the burden on the environment. Within this dynamic, the entire city stage is subjected to radical changes that inevitably prioritize economic benefits over environmental duties (Zaazaa 2022).

Climate change is often perceived as a self-contained 'environmental' matter, whereas it is an intersectional issue. Climate change impacts urban life, manifested in the rise in sea levels and the intensification

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of extreme weather events that affect human livelihoods and the built environment. However, urbanization and construction are key contributors to this, as they are among the largest extractive sectors for natural resources during construction, operation and even demolition processes. 'Estimates suggest that cities are responsible for 75 per cent of global CO_2 emissions, with construction being among the largest contributors' (UNEP n.d.). The nexus between the real estate sector and environmental quality is directly proportioned. Real estate contributes to 40 per cent of carbon emissions globally (Savills 2020), and global building stock is expected to double by 2050, with more people across the globe forecast to be living in cities (OECD 2011). The construction industry sector consumes 5 per cent of global energy and is responsible for 10 per cent of global emissions (GABC 2020). Cement production is the largest single industrial emitter of CO_2 and is responsible for 8 per cent of global CO_2 emissions (Ellis et al. 2019). These should be concerning statistics for anyone driving the sustainability agenda in the industry. Moreover, the real estate sector is expanding immensely, not taking its impacts into account but only concerned about market health.

The immense, ongoing and upcoming urban expansions that gain legitimacy through adopting new green technologies and building materials as well as green certifications as a way out or a golden solution encourage real estate investors to be heroes of climate stories and make money from it. Such sedatives remain impactless when fast-paced development and the urban frenzy to build spectacular spaces that are mainly directed at investments and profits take over city spaces, particularly when urbanization expands to create unnecessary real estate surplus to benefit the market instead of meeting social needs.

Real estate developers are now widely labelling their products as green and environmentally responsible projects, suggesting unrealistic indications that everyone will benefit from these projects, while they in truth only absorb what suits them and expel those who cannot afford them. This is a crucial and fundamental issue in understanding the reproduction of the ongoing environmental crisis and in framing the underlying political structures that create and sustain inequality in this new paradigm of real estate development.

This article highlights the environmental impacts of the real estate urbanization that Cairo is witnessing today by tracing the development of the policies of the real estate economy in Egypt and understanding the sector's current magnitude. I argue that most real estate production is a surplus that benefits only investors rather than fulfilling social needs. Relying on such a fragile economy can be very risky for the economy, society and the environment and requires reviewing and containment immediately.

LOCAL ENDORSEMENT: REAL ESTATE POLICIES IN EGYPT AND THE AGGRAVATION OF ENVIRONMENTAL DEGRADATION

> Prevailing development paradigms drive urban development strategies and interests that favour economic priorities at the expense of environmental policies and safeguards (Zetter and Hassan 2002, 169).

During the past decades, the Egyptian government has been aggressively promoting the real estate sector through processes of deregulation and privatization (Denis 2018). Lately, however, large-scale interventions have been planned, aimed at reshaping the state's economy, the physical urban fabric and socio-economic demographics. These critical conversions of the built environment and the production of a large stock of real estate surplus to absorb local and international capital encourage more commodification of the city's components of housing, public spaces and, lately, infrastructure. Consequences are reflected in uneven development, urban dilapidation and decay and a massive degradation of the environment.

These types of projects are not novel, though they are defiantly the most intense in terms of scale, magnitude and pace. They are the outcome of the evolution of a planned economy that has always prioritized real estate over other crucial social and environmental aspects. In the 1950s, extensive tracts of land were reclaimed from the rich, and agricultural land was redistributed to agricultural workers. A cornerstone of the agrarian reform project was the state claiming ownership of all desert land. 'Although people welcomed Nasser's rule – especially the poorer segments of society – the majority remained

excluded, as capital was transferred from the old bourgeoisie to a new bourgeoisie of technocrats' (Magdy 2014).

In parallel, Cairo has become more centralized and acted as a magnet, attracting numerous migrants from other parts of the country. In 1956, the first Greater Cairo Region (GCR) master plan was announced, which supported industrialization as a means of urban expansion with the provision of housing and infrastructure. This was done through expanding Cairo to the east in order to limit western urban expansion and protect cultivated land from encroachments (Municipality of Cairo 1957). Conversely, informal urbanization grew, stimulated by the continuation of internal migration, which outsized the government's ability to cope with its political commitments of providing housing and urban services. 'Practically all of

Figure 1. The informal growth of Cairo on western agriculture land, late 1960s. Source: Map by Ahmed Zaazaa, 2022. Map source: CoronaCast Satellite, 1966 to 1972. https://corona.cast.uark.edu/ (accessed 23 September 2022).

Cairo's expansion has been on rich agricultural land. Only the eastern districts, most notably Medinet Nasr, Nozha (and earlier Abassia and Heliopolis), have been created on what was desert land' (Sims 2003, 2). This degradation and loss of agricultural land affected the environment; moreover, overcrowded buildings lacked infrastructure such as sewage systems and potable water (Figure 1).

Although the poor planning and its consequences might have been unintentional and uncontrolled, official attempts at overcoming the negative impacts in an inclusive way were discouraging. 'Any discussion or negative assessment of the environmental consequences of development projects … were regarded as anti-state and thus faced hostile reaction from government … The prevailing ideology was that investment in environmental protection, pollution control and effective urban planning instruments would constrain economic growth rates' (Zetter and Hassan 2002, 173, 175). Official information about environmental impacts was restricted, and there were no channels for awareness and public pressure (Gomaa 1997). The real estate sector in Egypt was subject to more state control and intensified regulations in the 1960s, while other countries underwent a paradigm shift to include civil society in environmental advocacy (Ibrahim 1996).

The urban planning policies in the 1970s and '80s opened the door for today's urbanization boom. In 1970, the second GCR master plan (reaffirmed in 1982) enabled the massive opening of desert land to urbanization, especially towards the east, to start building the new desert cities (Cornu 1985). During this same period, informal settlements expanded rapidly, extending to include the desert's edge and continuing to consume agricultural land. The 'Open Door' economic policy, which encouraged and enabled the private sector to take over economic sectors – including real estate – continued to assert the primacy of economic development over other pressing needs. The primary aim was to create a flexible atmosphere for the private sector to take charge of development and remove the burden from the public sector. This included enforcing environmental measures on the private sector's investments. With the 'Open Door' policy, the problems were magnified, as needs for affordable housing were still ignored. Highly productive agricultural land was lost: during the 1981–1988 period alone, 340 square kilometres were converted into urban use (El Araby

2002). The government displayed minimal concern and control because the prevailing interest was in preparing for a new era of real estate development. As mentioned by a New Urban Communities Authority (NUCA) official, 'We have to complete our plans. We cannot look to see if people come or not. They will come' (Sims 2015, 126).

In the early 1990s, Egypt signed a programme of reform and economic liberation with the International Monetary Fund (IMF) and the World Bank (WB), which required even more reduction in public spending and encouraged more privatizations. These agreements led the government to use land as a profitable resource that could attract and expand the private sector's involvement in urban development. 'The real estate boom of the 1990s and the early twenty-first century changed everything … In less than fifteen years, the urbanized area of Cairo has almost tripled in size … land on the desert fringes, which is the property of the state, began to be sold without restraint or any overall plan to private developers. This transfer continues to this day, involving increasingly gigantic private projects' (Denis 2018). Such expansion has led to a tremendous increase in car mobility. The number of motor vehicles registered in the GCR increased from 0.5 million in 1980 to 2.4 million in 1992, at 13.5 per cent annually (GCUDS 1992), while emissions accounted for 60 per cent of all air pollution in the GCR (UNCSD 1997) (Figure 2).

Simultaneously, in 1992 – with the promise from Paris Club to reduce Egyptian debt by 12 per cent, to be allocated to environmental projects (Prosterman and Hanstad 1992) – the government signed the National Environment Action Plan as the first policy instrument to mobilize efforts and investments of both the government and international donors in dealing with environmental challenges. Two years later, the Environmental Protection Law was passed. These steps were crucial to take account of the pressing environmental needs, such as air and water pollution and waste management, enhance capacity and strengthen the institutional base. However, neither the action plan nor the law were concerned with the rapid urban expansion.

During the same period, the government facilitated the sale of more land to 'contractors' (later named real estate developers) for more urban expansion through bank loans guaranteed by the land. This evolved to allow the sale of units to the public from a plan, without construction

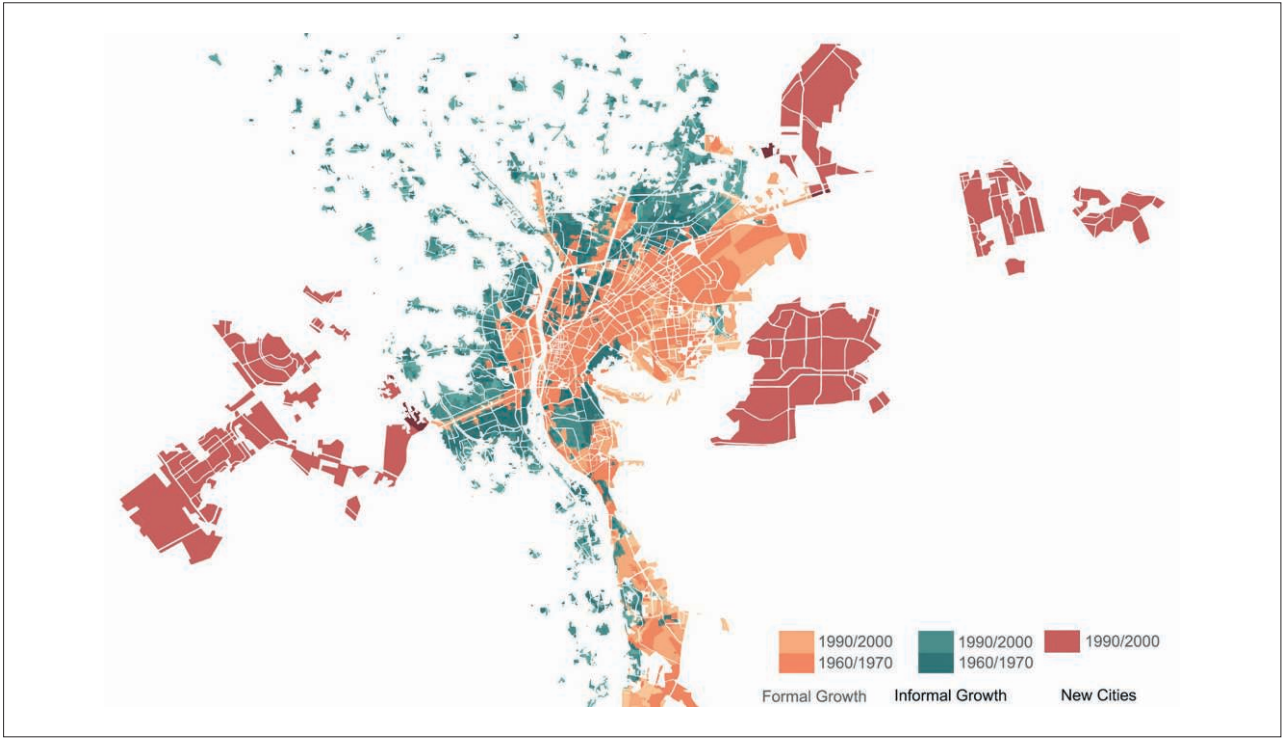

Figure 2. The growth of Cairo's built environment and the introduction of the new desert cities in late 1996.
Source: Map by Ahmed Zaazaa, 2022. Map source: Google satellite image, 1996.

having been initiated, to use the money for building costs. 'Huge tracts of land began to be sold at giveaway or below-market prices to an emerging new breed in Egypt, the corporate real-estate developer' (Sims 2015, 128). The contractors made profits while taking minimal risks, since buyers bore most of the projects' completion costs. These projects thrived on the market and resulted in more urban expansion. For example, housing compounds, recreation and service developments in the new city Sixth of October alone increased by 76 per cent from 1994 to 2000 (El Araby 2002). In 1998, the construction materials sector flourished and opened the door for the private sector and even international corporations to invest. Factories such as Germany's Heidelberg Cement, France's Vicat, Switzerland's LafargeHolcim, Greece's Titan Cement and Mexico's CEMEX invested heavily in Egypt's construction market (Werr 2021).

The reliance on the real estate economy increased income gaps rather than providing solutions for the most important problem: poverty. In 1995, the GCR population reached 13.4 million. Poverty, in terms of baseline measures, increased from 20.3 to 22.5 per cent from 1991 to 1996 (Sabry 2009) and reached 25.2 per cent by 2010 (UNICEF 2015). It is manifested in the ongoing shortage of affordable housing, leading to the continuation of construction on agricultural land.

In 2008, the 'gated community' typology was the largest trend in the real estate market. With the expansion of 'residential compounds' and 'gated communities', real estate appraisal jumped to a new level. Some gated communities were planned on plots as large as some European cities. 'Madinaty' (a gated neighbourhood east of Cairo), for example, was planned on thirty-five square kilometres, nearly the surface area of Cambridge in the United Kingdom. Even the public sector became interested in becoming a player on this profitable market, and public housing has given way to the extensive development of luxury apartments on the urban periphery. The urban elite have chosen the periphery to escape the deteriorating environmental conditions in the city, such as air and noise pollution and traffic congestion. The market even acted as a gateway for fast profits for middle-income groups. Small investors benefited from receiving small plots from the government; by land hoarding, they doubled their investments in only a few months.

TRADING THE SURPLUS

While the urbanization impacts on the environment emerged during the 1960s, evolved in the 1970s and 1980s and were consolidated in the 1990s and 2000s, the magnitude of urbanization after 2015 was inconceivable. The government reintroduced itself to the market as the landlord, the developer, the market manager and the promoter of the national project. Adopting these new roles went along with the entry of different state agencies into partnerships with real estate developers.

The resulting, even more complex urban structure that now exists bears the imprint of different approaches to real estate urbanization. The development of Cairo is going in two directions, which are separated geographically but share a vision to consolidate the real estate market. The first trajectory is the New Administrative Capital (NAC) and its spill over, which are to act as an alternative future for Cairo and have opened a new, giant market in the desert. It was announced in 2015 and intends to cover an area of 700 square kilometres of the eastern desert of Cairo, equal to the size of Singapore. The planned development is to include the new government and ministries' headquarters, central business districts and residential neighbourhoods, mostly directed at upper-middle incomes and above. It would also include the highest tower in Africa, an international airport set to be larger than London's Heathrow, a thirty-kilometre-long public park (larger than New York's Central Park), an amusement park four times the size of Disneyland to serve its residents and visitors and 10,000 kilometres of roads.[1]

The second trajectory is embodied in the Cairo 2050 plan, which focuses on gentrifying the city centre to justify another type of investment opportunity. The plan appeared in 2008 and is already being implemented to create a new image for the inner city and turn several traditional neighbourhoods into recreational/commercial and business centres. Accordingly, it is adding more land stock directed at real estate, neglecting indicators that show the area's saturation.

In a study comparing the population that NUCA aimed at for the new cities in Egypt with their actual population, the disparity

1. Advertising material collected from various magazines promoting the NAC.

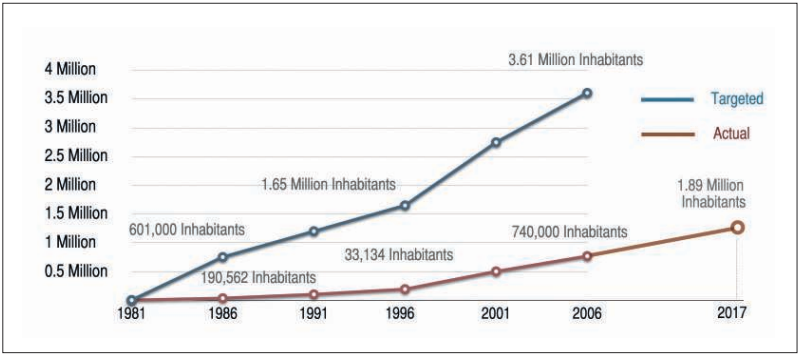

Figure 3. Targeted versus actual population in the new cities. Source: Shawkat, Y. 2013. "Social Justice and the Built Environment". *The Shadow Ministry of Housing*.

between the two figures indicates that new cities did not succeed in attracting inhabitants (Shawkat 2013).[2] NUCA aimed at 3.61 million inhabitants but was able to attract less than a quarter of these in 2006. Even eleven years later, in 2017, the population increased to only 1.89 million (Figure 3).

While buildings are being constructed continuously, most remain empty and serve only investment objectives rather than having the social use of housing. '[In 2015,] vacancy rates for all units counted in Sixth of October and New Cairo reached 61 percent and 63 percent respectively. In Sheikh Zayed vacancy rates were 69 percent, in al-Badr New Town 71 percent, and in al-Shuruq 79 percent' (Sims 2015, 150). Moreover, the general number of vacant residential units in Egypt reached 11.7 million in 2017 (Central Agency for Public Mobilisation and Statistics [CAPMAS] 2017).

David Sims points to the population increase in the decade between 2006 and 2017: the CAPMAS census showed an increase of five million inhabitants in the GCR's population, with formal neighbourhoods accounting for 12 per cent of the population increase. While the new cities, which hardly include 6 per cent of the population, were able to accommodate only 12 per cent of the increase, the informal

2. Comparing NUCA's data on its targeted population and actual population data from CAPMAS.

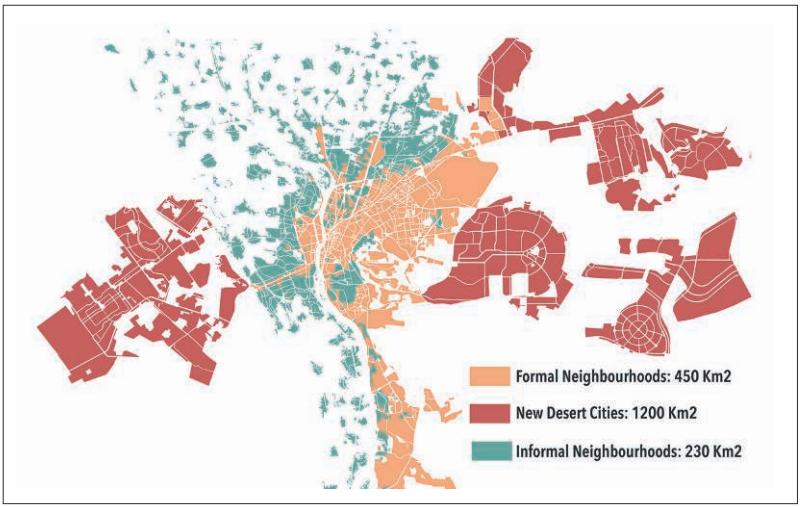

Figure 4. Evolution of the three main urban typologies shaping Cairo. Source: Map by Ahmed Zaazaa, 2021. Map source: CAPMAS Data, analysed by David Sims, 2019.

settlements – already containing 69 per cent of the total population of the GCR – absorbed the rest of the population increase (Sims 2019). Such statistics show the incapability of the new cities' real estate to contribute meaningfully to solving the GCR's problems. They also revealed the niche group that this typology aims to attract (Figure 4).

This surplus is also observable from the satellite images revealing all uninhabited villas that are left unfinished until today. These projects launched their units more than six years ago, but, regardless of their empty stock, some are launching their new phases soon (Figure 5).

These statistics and observations show the saturation of the residential stock, to the extent that there is already a colossal surplus. However, these alarming statistics never stopped the rollercoaster, and there was even room for more, as they coincided with the launching of the NAC and a handful of other mega residential projects (Nour City/Capital Gardens, New October and New Sphinx in Cairo; New Alamein and New Mansoura in and around the Nile Delta). The government's injection of large public investments in the infrastructure sectors encouraged the growth of the real estate sector. NUCA offered 15,000 land plots in only three of its numerous projects in east Cairo

Figure 5. Upper left image: Palm Hills – October Gardens, 2022 (sales started 2017); upper right image: Alegria – Sheikh Zayed, 2022 (sales started 2016); lower left image: Madinaty – New Cairo, 2022 (sales started 2016); lower right image: Qattameya Dunes – New Cairo, 2022 (sales started 2017). Source: Google Earth satellite maps, 2022.

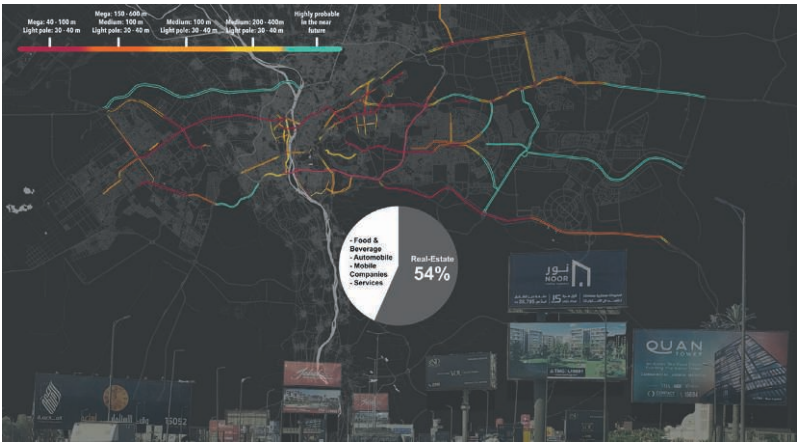

Figure 6. Mapping mega billboards in the GCR, numbering over 3,500. Most are used for real estate advertisements, dominating public spaces and main roads and arteries. Red lines indicate that these billboards can be only 40 metres away from each other. Source: Map by Ahmed Zaazaa, 2021. Map source: Field mapping.

(NUCA 2016). In 2016, new cities received public investments equivalent to all other Egyptian villages and cities combined (which house 98 per cent of the population; 10 Tooba 2016). In 2018, the construction and real estate sectors accounted for 16.4 per cent of GDP, making them equivalent to the relative weight of the entire industrial sector in Egypt (Ramadan 2019). These figures increased in 2022 to reach 18.5 per cent (11.4 per cent for real estate activities and 7.1 per cent for construction) (Shawkat 2022). While 80 to 85 per cent of housing demand is directed at affordable housing (Abdel Hamid 2018), high-end housing advertising dominates the 3,500 mega billboards in the GCR (Figure 6).

The real estate rumble is not limited to residential activities. According to a report by JLL (2021), total commercial space available for lease reached around 2.3 million square metres in 2020, in Cairo only. That adds around one million square metres of commercial space, an increase of 77 per cent compared to 2016.

All these projects in Cairo (implemented or planned) are stretching the urban region to an alarming scale (Figure 7).

QUANTIFYING THE ENVIRONMENTAL PRICE

The massive urbanization and real estate development projects need construction material to fuel their growth, which comes with more direct costs for the environment. According to the Climate Watch Platform, in 2015, Egypt ranked number 30 worldwide among the biggest emitters of greenhouse gases (GHG) in the building sector (Climate Watch n.d.). Construction accounts for at least 23 per cent of GHG emissions, industrial process and product use (IPPU) contributes 12.5 per cent, while construction material production is responsible for 75 per cent of IPPU emissions (EEAA 2018). Construction and demolition waste in general contribute about 50 per cent of total global annual solid waste (Daoud and Bayyati 2020).

There is no doubt that the government's reliance on cement as a main building material in its urbanization programme enlarges the carbon footprint. The production capacity was ranked eleventh in the world between 2010 and 2020 (Enterprise 2020). In 2014, cement production contributed to 6.85 per cent of all CO_2 emissions in Egypt (Knoema n.d.), jumping to 8 per cent in 2018 (EEAA 2018). Regardless, cement

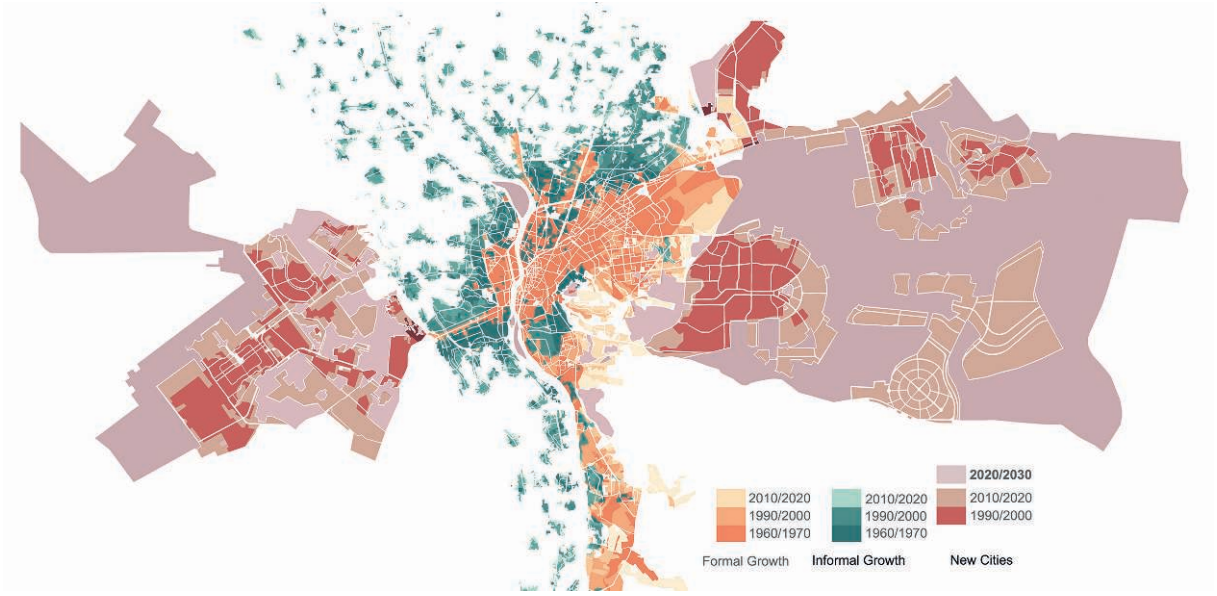

Figure 7. Actual expansion between 2010 and 2020 and the planned expansion of Cairo by 2030.
Source: Map by Ahmed Zaazaa, 2022. Map source: Google satellite image, 2020, and official expansion plans.

production capacity in Egypt expanded and exceeded demand significantly. In 2017, it reached 74.3 million tons/year, while demand in the same year was 53.9 million tons (CID n.d.). In 2018, the government built one of the biggest cement factories, with a production capacity of 13 million tons/year. The new factory is so massive that the Chinese vice president of Simona, the company responsible for mechanical work in the factory, told Reuters: 'It is the biggest plant to be built all at one time … We haven't had anything like it in China' (Werr 2018). In 2021, cement production capacity doubled to reached 84.5 million tons, while demand was only 47.8 million tons (CID n.d.).

Egypt's urbanization plans require other energy-intensive construction materials, such as steel, of which Egypt is the largest consumer in the Middle East and North Africa region (OECD 2020). Steel production contributes 1 per cent of Egypt's CO_2 emissions. In addition, numerous other construction materials – paint, insulation, ceramics, bricks and stone – all come at great expense to the environment, not only in terms of GHG emissions but also in terms of their very high consumption of water and energy.

Egypt is the ninth-most water-stressed country in the world (Maplecroft 2011). Egyptian president Abdel Fattah el-Sisi recently revealed that the country has reached the stage of water poverty, with less than 500 cubic metres of water per capita available annually (Alaa 2021). However, this did not change the provision of luxurious amenities in the new real estate development projects, such as large golf courses and artificial lakes, which quickly became primary parts of marketing plans for high-end housing in Egypt. Out of twenty golf courses in Egypt, Cairo contains thirteen (El-Kholei 2020). Twelve courses are located in different gated communities. The average golf course needs about one million cubic metres of water per year, which is equivalent to the water consumption of a town of 12,000 inhabitants (Wahba 2021). All this puts unnecessary stress on a country that already suffers from water scarcity.

The published master plans and visualizations of the NAC have also raised concerns about the energy needed for the proposed architectural model. Glass skyscrapers are the main feature, which will create a great demand for energy needed for thermal comfort in the buildings as more heating, ventilation and air conditioning systems

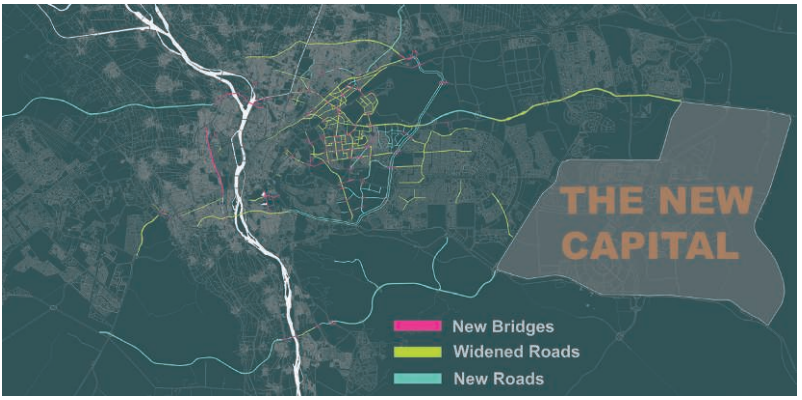

Figure 8. New roads and bridges in the GCR between 2020 and 2022. Source: Map by Ahmed Zaazaa, 2022. Map source: Google Satellite and field mapping.

are required to overcome the greenhouse effect resulting from the glass facades. An estimation showed that NAC alone will consume 1.5 million cubic metres of water a day (Michaelson 2018). A similar approach is followed in most of the Cairo 2050 plan: building glass high rises in the city centre of Cairo.

Additionally, the planning approach encourages reliance on motor vehicles in the desert cities. The new desert cities required modifications in the city centre so it could accommodate new road networks, directed particularly to the NAC. East Cairo witnessed enormous urban interventions, where hundreds of highways and bridges penetrated the city centre. Between 2020 and 2022, more than 107 bridges were constructed in Cairo alone, dozens of inner roads were drastically widened, and new roads were built, cutting through residential neighbourhoods. The architect Norman Foster commented: '[One] has to question why Egypt is building huge roadwork when elsewhere in the world the lessons have been already learned … building motorways for something already extinct like a dinosaur' (Moustafa 2022) (Figure 8).

The incremental expansion of the GCR encouraged more dependency on motor vehicles because distances became significantly larger. In return, sixty-five new petrol stations owned by the government were added to the GCR between 2018 and 2022. In some cases, these stations substituted basic urban services, such as plant nurseries, central markets and central bus stations (Figure 9).

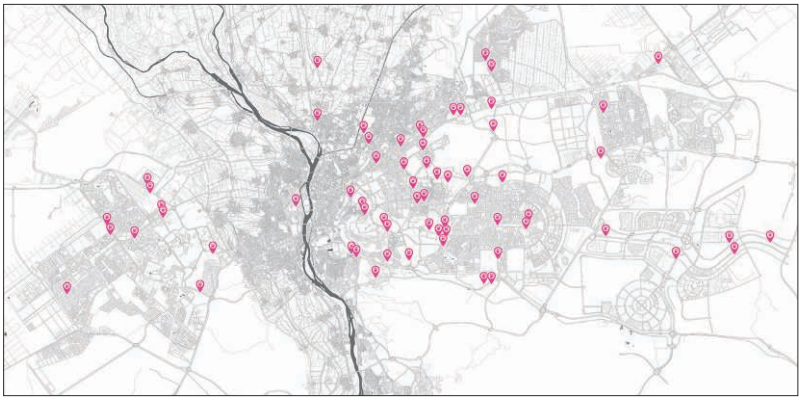

Figure 9. New petrol stations added between 2018 and 2022. Source: Map by Ahmed Zaazaa, 2022. Map source: Google Maps and field mappings.

The new infrastructure built to serve the real estate development in the east of Cairo has destroyed immense green areas due to road widening and bridge construction, which directly affects the urban heat island effect (HIE) in these areas. Cairo's green spaces were already rare, as the individual share of green public spaces was 1.5 square metres in 2003, compared to 16 square metres on average in European cities (Al-Zafarani 2003). However, in 2020, around 390,000 square metres were lost, specifically east of the city, due to urban interventions (Monte Carlo Doualiya 2021). This is equivalent to fifty-four football fields. In addition to the loss of trees and green areas that used to reduce the HIE, as they created shaded areas and increased humidity (Kumar 2013), replacing green areas with asphalt increases the urban HIE by increasing the air temperature during the day and radiating absorbed heat at night, creating a continuous heat effect (Fathallah and Ragheb 2022). The photo in Figure 10 is just one example of the many cases that eastern Cairo witnessed (Figure 10).

The new roads and bridges also required the demolition of a huge number of residential buildings and the relocation of their residents. The social impacts of these demolitions are immeasurable and symbolize the core of climate injustice.

Figure 10. Example of road widening and losing green spaces. Source: Photos posted on social media by neighbourhood residents.

SETTING OUR PRIORITIES

Egypt has been present at several international environmental events. It has signed the Kyoto Protocol and Paris Agreement. It was involved in the Climate Summit, the Millennium Development Goals and the Sustainable Development Goals. It is also a member of the United Nations Framework Convention on Climate Change (UNFCCC) and the International Environmental Agreement. Yet, to which extent these agreements and memberships have helped Egypt combat climate change remains questionable.

International organizations are witnessing and even supporting and praising the market-based solutions approach to climate change, with fewer concerns about climate justice. In the 1990s, when the real estate market was established and proved how extractive it can be, Western donors praised Egypt as a neoliberal success story (Osman 2011). In 2008, UN-Habitat supported the Cairo 2050 plan, which preserves the business-friendly spirit and plans for new, gigantic high-end residential and commercial projects and the relocation of thousands of residents. Also, at the peak of the unprecedented real estate expansion in 2021, UN-Habitat awarded NUCA the Scroll of Honour Award in the field of sustainable urbanization (*Ahram Online* 2021). Egypt also received praise during the Third Global Ministerial Conference on Road Safety in Sweden (Mansour 2021), while in the same year the death rate from road accidents in Cairo was exceptionally high (Saad 2022). These are simply examples we can provide to

question how likely it is that international donors will support real change that might contradict the economic factors that contribute to climate change and injustice. There are no signs of attempts to reduce growth over production and consumption.

Focusing on our priorities is crucial. Egypt is already making appreciated efforts in reducing industrial emissions. The energy sector is expanding with solar and wind farms, improving energy efficiency in the industrial sector and has started awareness campaigns to reduce water consumption. Egypt also began to develop crops adapted to higher temperatures and enforce irrigation systems that help save water. And in the construction sector, Egypt is endorsing green cement and encourages green building certifications. However, compared to the magnitude of unstoppable urban expansion, these efforts can be negligible.

It is very risky to depend on a fragile economic resource such as real estate, which can easily collapse as a reaction to numerous events, even simple rumours. With any downfall in this market, the environmental agenda falls to the bottom of the priority list, as at the top of the list will be overcoming the economic crisis. And the history of prioritizing this sector and it becoming an economic pillar shows that it was never successful in solving the most important needs. On the contrary, poverty rates in Egypt have reached unprecedented figures, hitting 32.5 per cent in 2017. Even when it declined to reach 29.7 per cent, it is still far worse than during the previous decade. On the contrary, poverty spiked in 2020, alongside the real estate boom (*Ahram Online* 2022).[3] Moreover, the government encouraging investments in this market and marketing it as the safest haven for Egyptians' savings drastically reduces opportunities to diversify local investments among more sustainable and stable markets, such as agriculture, energy, industry and tourism (Adly 2016).

For any meaningful policy shift, a change of perspective is necessary, not only in Egypt but globally. The development of cities' political economies, the climate and the environment are deeply interconnected by a web of complex relations and interdependencies, held in a

3. According to CAPMAS's report for fiscal year 2019–2020, nearly 30 per cent of the Egyptian population lived below the poverty line (around thirty million Egyptians).

precarious state of balance. Changing one component forcibly reconfigures the entire system. Evaluating the success of a development strategy must entail an assessment of the losses that its interventions have caused. Structural indicators to assess overall gains and losses are crucially needed to understand the bigger picture of the development ecosystem instead of perceiving the construction industry, real estate development and the environment as separate issues and hence applying separate success criteria. The management department of the Ministry of Environment produces environmental impact assessment reports for urban development, which cover various aspects on different levels. But an independent review of government plans to ensure their environmental soundness is needed to overcome any political constraints. Scientific, independent assessments are crucial, conducted only by representatives of civil society and academia from the Middle East and North Africa region. They can evaluate and connect interrelated impacts and weigh benefits against losses through both holistic and intersectional frameworks. Governments should be obliged to provide this platform with access to transparent information about urban development projects to enable cross-disciplinary assessments, including environmental, social and economic impact assessments. This can be a step in enabling development with realistic and impactful strategies to reduce losses.

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LAND POLICY AND ENVIRONMENTAL JUSTICE: THE CASE OF PUBLICLY OWNED PROPERTIES IN LEBANON

INTRODUCTION

Some of the most radical urban struggles we have witnessed in Lebanon arose in the face of urban projects or buildings that had not yet been implemented. These struggles were informed by people's knowledge of these projects' devastating environmental, social, economic and psychological consequences. It is not surprising that a lot of discussion and movements are built around future constructions and that objections to these projects and attempts to prevent them become

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* **Public Works Studio** is a research-based organization made up of urbanists, architects, designers, researchers and legal experts critically engaged in public and urban issues. By taking a right-to-the-city approach, their work addresses spatial inequality and social exclusion in Lebanon as these affect residents whose livelihoods, housing and surrounding environment are being destroyed by neoliberal urbanization and real estate speculation. www.publicworksstudio.com

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aggressive, since all those involved – protesters, residents, politicians and real estate developers – are well aware of what is at stake. We have supported, followed and participated in campaigns, obstructive movements and interventions and even direct confrontations with security forces to stop real estate projects that were approved by the Lebanese authorities. This started with opposition to the Solidere project[1] in the 1990s and has recently included protests against the construction of the Bisri Dam, the privatization of the Dalieh area of Raouche, the construction of the Eden Bay resort in Ramlet al-Baida and the Fouad Boutros highway in Rmeil, the planned construction over the Anfeh salt evaporation ponds and the destruction of the fishermen's port in Adloun.

Hence, the struggle over land includes what exists as well as what does not yet exist; it is a struggle to preserve the land as we use it today and a fight against what is planned for tomorrow. The pace of construction and its price affect everything, from housing to agriculture, to the environment, to transportation and beyond.

An increasing number of people in Lebanon are being displaced from their lands and homes in order to make room for huge projects. The destruction of agricultural land by real estate speculation has led to local food inequality, which in turn has contributed to increased displacement from rural to urban areas and the impoverishment of marginal areas. Measures taken in land administration and regulation are also contrary to the interests of the people and their environment, health and mobility, especially for those who depend on land as a means of subsistence, survival and the preservation of their human rights.

Indeed – as highlighted by the United Nations' *Land and Human Rights* report – 'growing global concerns about food security, climate change, rapid urbanization and the unsustainable use of natural resources have all contributed to renewed attention to how land is being used, controlled and managed' (Office of the United Nations High Commissioner 2015). These questions have thus become essential in discussions around environmental justice, simply because land is not a commodity but rather a comprehensive issue that directly

1. Solidere is a private real estate company that was handed the reconstruction of Beirut's downtown in 1994. It was founded by the late prime minister Rafic Hariri.

affects a number of basic rights. Land is also specified by its content and connotations; it is the source of life and a place that is lived in. One particular question in this discussion is the future of public land.

In Lebanon, the state owns a substantial part of the territory, estimated to range between 20 and 25 per cent of the country's total surface area. These publicly owned properties – the unbuilt ones – constitute our natural and ecological environment. They are a national asset directly linked to our ways of life and diverse livelihoods across Lebanese regions. Yet these public properties are the newest target of privatization through multiple government plans. Faced with these risks, Public Works Studio embarked on an in-depth research project to answer the following questions: What kind of land is owned by the Lebanese state? Where is it located? What social value does it hold? And what do we stand to lose if the state concedes this land? (Public Works Studio 2022). By answering these questions, this paper advocates for the need to preserve public land as a right for future generations and makes a case for why the oligarchic plans to privatize state lands must be resisted – in Lebanon and elsewhere. We further argue that the public ownership of land has played a detrimental role in safeguarding its environmental and social value against neoliberal urbanization and real estate construction projects.

PRIVATIZATION: A TOOL FOR THE OLIGARCHY

In light of the ongoing financial and economic collapse of Lebanon, recent mainstream public discourse in the country has focused on the privatization of public assets as a means to save the state from imminent bankruptcy. It began on March 10, 2020, when Mohammad al-Mashnouk, then Minister of the Environment, presented the prime minister with what he marketed as 'a solution to the crisis of fears about the fate of bank deposits' (Sayegh 2021). Al-Mashnouk's 'solution' was practically a carbon copy of the plan that the Association of Banks in Lebanon (ABL) would release two months later under the title 'Contribution to the Lebanese Government's Financial Recovery Plan' (Association of Banks in Lebanon 2020).

Though they are packaged differently, both plans call for the establishment of a fund – to be called either 'the Sovereign Fund for the Management of State Property' or 'the Fund for Government Debt

Relief' – that would allow private banks to seize various assets held by the Lebanese state, including real estate. The ABL plan even specifies that the state assets in question must be valued at approximately USD 40 billion – allegedly to match the amount owed by the state to the central bank – and that they must include 'some or a combination of shares in state-owned enterprises (e.g. telecommunications), public lands and other public real estate assets, and/or exploitation rights/concessions (e.g., Lebanon's waterfront)' (Association of Banks in Lebanon 2020).

By July 2020, other dangerous ideas to privatize state land had made their way into Parliament in the form of several bills. One such bill, sponsored by the Loyalty to the Resistance Bloc in September 2020, sought to legally reclassify a type of state land that has traditionally allowed for communal use (known as *amiri* land) and consequently privatize it (Public Works Studio 2021). Although very different from the Sovereign Fund, this bill exemplifies the clientelist nature of policymaking in Lebanon, whereby parliamentarians – under the pretext of meeting the needs of their constituencies – transform land rights into circumstantial services provided by these representatives, in this case at the expense of public assets.

Through these moves, land that belongs to the Lebanese state is the newest target of the privatization that has proved so exclusionary and detrimental to Lebanon's most impoverished populations. Contrary to what advocates for privatization claim, the sale of state land is unlikely to generate the profits needed to pay off the state's debt or compensate for the losses caused by this crisis (Kostanian 2021). What is likely, however, is that such sales would further constrain the Lebanese state's capacity.

The current threat of privatization also follows a history of national policies that systematically commodified land and threatened the public realm. For the past decades, land policies in Lebanon have emerged as a tool for consolidating the real estate rentier economy and as an opportunity to accumulate wealth, rather than as a means of achieving social justice and managing resources. In fact, the services sector accounts for about 77 per cent of the total Lebanese economy (Dewailly 2019) and an abundance of research has demonstrated that most revenues are generated by land and housing development for

the benefit of a group of traders or speculators in real estate prices. This has put the social function of land under severe strain and has destroyed productive economies tightly linked to natural resources.

Long-standing policies in Lebanon have also robbed and neglected the public domain. One such policy is the use of legal loopholes to reclassify state lands, thereby removing restrictions on their use. The Lebanese state owns two categories of property: public state property and private state property (Lebanon's Real Estate Property Law, Resolution no. 3339 of 1930). These categories are consequential because they determine what the state can and cannot do with its properties. When it comes to its 'private' property, the state – under conditions that differ according to land type – can sell, cede or lease this type of property in accordance with relevant law.

In contrast, the state's 'public' property – legally known as 'reserved protected land' – can never be sold. It includes any property meant to be used in the public interest, such as riverbeds, riverbanks, seashores, waterfalls, lakes, irrigation canals, roads, paths, sidewalks and storm drains, among others. This type of property is 'protected' because the state cannot sell it or dispose of it, nor can ownership over it be acquired over time, unless it is first redesignated as 'private' to remove these restrictions – which is precisely what has happened over the years.

We collected and analysed data from the Official Gazette on reclassifications of public state property as private state property between 1922 and 2022. We found many cases where public state property was redesignated under the pretext of 'serving the public interest', a loose concept that seems to correspond to the individual economic and political interests of the day's decision makers (Abou Rouphaël 2022). This legal loophole has been used to facilitate investments that should have never been allowed to occur and to encroach on integral elements of our natural and built environments. Only in a few cases could the request to redesignate property be justified on the basis of serving the public interest. For example, the Ministry of Education requested a reclassification of a plot in order to build a public school on it; the property became 'private state property' and ownership reverted to the ministry. Yet, only in 7 per cent of cases was a request to reclassify property initiated by an official entity (a ministry, agency or municipality). In contrast, 83 per cent of requests

to reclassify property were initiated by private parties, such as individuals, companies, an endowment, a syndicate, an association etc. Requests were often made by owners of neighbouring real estate.

Another type of loophole used to remove the 'public' designation from state property appears in the context of infrastructural renovations of protected properties, such as roads, channels or canals. Because old infrastructure can no longer serve the public interest – according to decision makers – they can be reclassified. We found this pattern in 26 per cent of cases. And when we dug into specifics, we found that these redesignations were used to buy political loyalties in clientelist networks.

The history of state land reclassifications showcases how Lebanon's politicians engage with protected lands as mere commodities that can be turned into financial profit and political capital. Under legal cover, the public domain has been offered to those in power on a silver platter.

THE LAND WE STAND TO LOSE TO THE SOVEREIGN FUND

The public domain of the state includes maritime properties, such as beaches, sands and seawater as well as riverbeds, shores, waterfalls, natural lakes and ponds, to name a few. Lebanon has already lost a portion of this natural environment through decades of legalizing the illegal redesignation of these lands for the sake of economic and personal interests. Yet with the possible establishment of the Sovereign Fund, the losses are far larger than what we have witnessed for the past decades.

The private domain of the state accounts for about 57,201 properties. It is made up of Republic and Treasury properties (54 per cent), the Commons (8 per cent)[2] and properties belonging to various ministries, the Council for Development and Reconstruction (2.5 per cent), Banque du Liban (2 per cent), various municipalities all over Lebanon and other administrations, such as the Litani River Authority and housing institutions (T. Alaeddine 2022).

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2. We use 'Commons' here to refer to all properties where the name of the owner is 'the general population/residents/property holders' of a named locale and to *musha'*, *mar'a* and *baydar*.

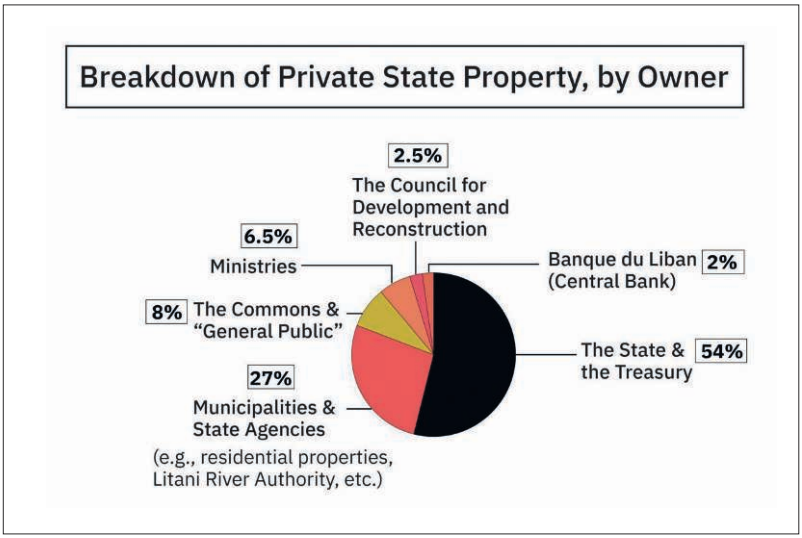

Figure 1. Breakdown of private state property, by owner type. Source: Diagram produced by Public Works in 2021 after compiling 2015's data from Ministry of Finance records.

Departing from these numbers, the losses are numerous. Looking closely at the records of the Ministry of Finance, 2,773 properties are listed under the name *musha'* (communal), 408 are designated as *mar'a* (pasture) and 125 as *baydar* (threshing floor). In 1,253 cases, the proprietor is 'the general population/residents/property holders' of a named locale. These lands are distributed unevenly across Lebanon.

The mere existence of these various concepts is in itself evidence of a long-standing, organic relationship between people and land, one grounded in collective, public use rather than individual ownership. Their respective meanings also capture the diverse practices and uses of land in Lebanon, beyond our dominant modern framework that tends to associate the public domain only with gardens or parks. *Musha'* refers to land shared by the general public, equally, without exception and with no individual owner. *Baydar* is flat land used for threshing wheat and barley (i.e. separating the grain from the chaff after the harvest). *Mar'a* is pasture: wild, uncultivated land with vegetation suitable for grazing on which herds of livestock can subsist.

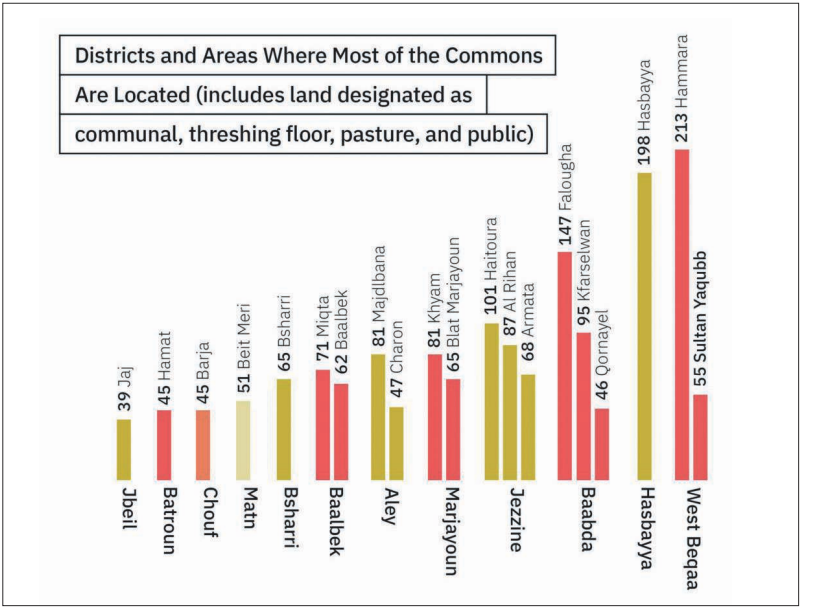

Figure 2. Top twenty Lebanese locales with the highest number of Commons. Source: Diagram produced by Public Works in 2021 after compiling 2015's data from Ministry of Finance records.

The fourth designation, 'general population/residents/property holders of X town', refers to specific localities.[3] In some instances, the lands are meant for the use of all those whose civil status (*nufus*) is tied to that town; in others, it is for all registered residents of the town, even if their civil status is tied to a different locale and even if they are not Lebanese nationals. And in some cases, use of the land is limited to all holders of property in the town, even if they are neither residents nor civil status holders.

Some attribute this fourth designation to the mid-nineteenth century social revolution, in which peasants took control of the lands they were working under feudal lords (Milan 2016). When the Ottoman Empire began to enumerate lands with the intention of imposing taxes

3. In Arabic: سكان بلدة ما / عموم أهالي or عموم المالكين في بلدة ما.

on the population, these peasants claimed that the areas belonged to the 'general population' in order to evade taxation.

Across their different names, these lands refer to locations that have always been reserved for the public benefit, with equal access to the land and its resources, far from conceptualizations of private property as paramount. Today there is a growing concern with protecting them as living practices of the organic relationship between people and the land at the local level and as expressions of the diverse lifestyles, traditions and socio-cultural practices of communities.

Another element worth protecting, or rather resurrecting, is the housing component of state property. The Lebanese state owns thousands of properties designated for housing (R. Alaeddine 2022) and registered under the name of several ministries, departments or directorates concerned with housing, such as the National Authority for Reconstruction, the Ministry of Housing and Cooperatives, Public Housing or the Housing Authority. None of these institutions exist today, as all have been subsumed under the Public Corporation for Housing (PCH).

The state's direct intervention in the housing sector can be traced to the mid-1950s, with the construction of the first public housing projects. These projects were conceived not to service populations in social and economic need but rather as a response to waves of displacement caused by natural disasters. In 1956, in the aftermath of a devastating earthquake in the Chouf Mountains and the south of the country, the National Authority for Reconstruction was established. The agency acquired real estate in sixty-seven affected areas, constructed homes and buildings for those affected and sold real estate to others so they could build their own homes.[4] An identical process was followed when the Abu Ali River in Tripoli flooded multiple times that same year. The agency was short-lived, as it was abolished only a year later.

Proposals for social housing projects soon followed, but most did not see the light. Yet, under pressure from unions, and considering that one of the main obstacles to building affordable housing was the

4. According to Rony Lahoud, current PCH Director. This statement was shared during the groundbreaking ceremony of the municipal building in Anan back in 2019.

scarcity and high cost of property, Parliament passed legislation in 1965 to enable the government to acquire land and resell it to parties wishing to build (Sadik 1996). The Ministry of Public Works and Social Affairs was supposed to facilitate the construction of 4,000 housing units, half of which would be reserved for low-income families. Three projects were started: 192 units in Tripoli, 96 in Tyre and 400 in a suburb of Zgharta. Not all were completed, for different reasons, and the programme was eventually dropped.

This was the closest Lebanon came to building social housing projects. Since the end of the civil war, practically the only work that the PCH has done in this domain is facilitating loans for home ownership.

It is imperative to preserve state properties designated for housing in official records, for they can be key to a national housing strategy that is affordable and inclusive, coupled with environmentally sustainable practices. In the current context of exclusionary policymaking, access to shared space is restricted and planning practices produce poor housing and worsening health for residents.

THE ATTACK ON *AMIRI* LANDS

Privatization plans were not restricted to the government proposal to establish a sovereign fund but also occurred in Parliament, where Lebanese politicians recently tried to intervene to transform a specific type of private state property, *amiri*, into another type of private property, *mulk*.

There are four types of private state property in Lebanon: *mulk*, *amiri*, *matruk* and *mewat*.[5] Each comes with a specific bundle of rights. *Amiri* lands – a legacy of Ottoman rule, as their name implies – are properties officially owned by the state, but non-state actors can acquire the right to use and benefit from them (usufruct rights). Any individual or group who utilizes an *amiri* property (or sections of it) in a regular, public, uncontested manner continuously for ten years can acquire rights to it. These rights mainly include planting, harvesting, excavating (at any depth), extracting materials from the excavations,

5. *Mewat* is a type of *amiri* that is unusable due to the nature of the topography or ground.

disposing of this material and renting out the land or lending it to others. These rights are forfeited if the land is not used for five consecutive years, in which case they revert to the state. Holders of these rights can also transfer them to others or bequeath them to their descendants, with equality between women and men. However, the state always reserves the right to sell *amiri* lands, transfer ownership or turn them into an endowment.

This particular category of land is extremely significant; it is really ingrained into the understanding of the social value of land, because the right to use it 'forces' its use. Additionally, the rights associated with *amiri* lands make them accessible to marginalized communities. For one, the use of *amiri* lands is free of any payments to the state, making them an option for those without the economic means to purchase or rent property; a person does not need to own land in order to cultivate it, live on it or use it. The use of *amiri* lands is also not conditional on having the Lebanese nationality, which makes it accessible to Palestinian, Syrian and other foreign nationals. Perhaps most notably, the fact that the right to use *amiri* lands can be inherited equally, regardless of gender, expands access for women, especially for those whose inheritance of other types of property is governed by Islamic sharia, which grants them half the share of men. Moreover, the fact that a single *amiri* property can be used by many individuals encourages communal and collective management of the land – a rare exception in a landscape that sanctifies private property.

Amiri lands constitute the majority (52 per cent) of all real estate belonging to the Lebanese state, or 31,907 different properties. They consist primarily of agricultural lands, with 78 per cent located in the Bekaa region, where three quarters of residents live off agricultural work. Given that the Bekaa is responsible for a large percentage of the country's total agricultural production, another benefit of the *amiri* designation is that it protects the agricultural sector from market speculation.

On July 15, 2020, Ghazi Zaiter and Hussein Hajj Hassan, two MPs from Baalbek-Hermel representing the Loyalty to the Resistance Bloc, presented a bill in Parliament to turn *amiri* properties into *mulk*, which would revert all rights of use to the owner (Public Works Studio 2021). To defend their proposal, they argued that *amiri* lands violate the 'constitutionally enshrined free market system that guarantees private

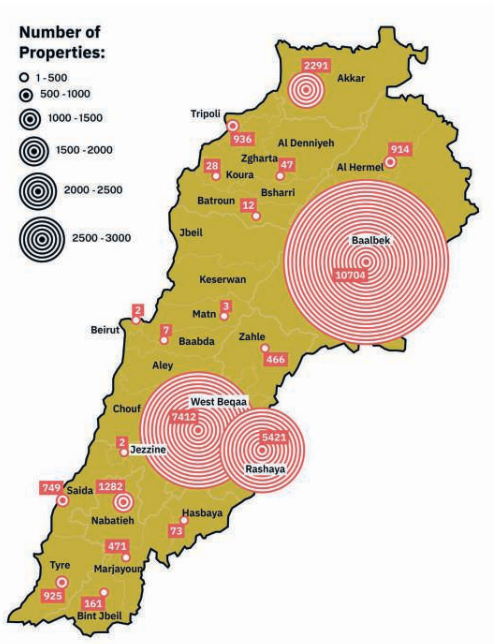

Figure 3. Geographical distribution of *amiri* state property. Source: Map produced by Public Works in 2021 after compiling 2015's data from Ministry of Finance records.

property' and create inequality between regions (Zaiter and Hajj Hassan 2020). Running through their proposal is a narrow, problematic understanding of development and growth that measures only total profit, regardless of how it is distributed. It is indifferent to the creation of sustainable employment opportunities for the broader community.

If their proposal comes to pass, given the overall context of land policies in Lebanon, *amiri* lands will be reclassified from private state properties into private properties and fall into the hands of a powerful few, which will eventually open the floodgates to speculation over the sale of agricultural lands. Equality between women and men in inheritance will also be abolished, and residents who do not hold Lebanese nationality will be negatively affected – especially Palestinians, whose ability to use *amiri* lands and benefit from agriculture is a rare reprieve

Figure 4. Fertile agricultural fields on *amiri* state land surround the Palestinian refugee camp of Rashidiya in southern Lebanon, 2021. Source: Photo courtesy of Public Works Studio.

in a system that severely limits their right to work and bans them from landownership (Law no. 296 of 2001).

The city of Tyre in the south Lebanon is an example that truly demonstrates these risks. *Amiri* public lands constitute 62 per cent of Tyre's area, while state-owned lands of all types amount to 70–75 per cent of the city. The current uses of these lands are diverse, but most are used for agriculture, supporting Palestinian and Lebanese families. More than 123 Palestinian farmer families from Rashidiya camp use the nearby *amiri* lands. They have reclaimed and cultivated the land without interruption since they arrived in Lebanon after the 1948 Nakba. These cultivated *amiri* lands kept the residents of Rashidiya camp steadfast during the siege of the camps in years 1985–1986.[6]

If the proposed law is passed, the losses will not befall Palestinian families only but will affect the entire city and everyone who visits or works in it. These are not only economic losses but also social, agricultural and ecological losses related to the inherited cultural uses of the

6. According to interviews with Palestinian farmers conducted in Rashidiya camp in southern Lebanon, 2021.

land by those who first started using it without the obstacle of 'private property'; that is, without attempting to transform land and nature into a commodity.

RE-EMPHASIZING THE BUNDLE OF RIGHTS EMBEDDED IN LAND

Amid the Lebanese state's collapse, it is imperative that it does not cede lands that are currently sustaining the livelihoods of many communities through shared access to resources. These lands also hold the key to more sustainable and equitable responses to social needs, from access to housing to a fair distribution of the losses of the current crisis.

Holding a fire sale of state properties now or allowing private entities to manage them prioritizes private over public interest, robs future generations of their public domain and further erodes the state capacity needed to pursue social justice. What we need now is precisely the opposite of privatization: to re-emphasize the value of the public domain as a shared environment and of the state's role in managing it as a source of livelihoods, production and ecology.

The case of publicly owned land in Lebanon brings questions of who owns the land, who has access to it, who controls it and how it can be used to the forefront of the climate change debate. Indeed, the *Special Report on Climate Change and Land* (United Nations Intergovernmental Panel on Climate Change 2019) provides a comprehensive view of the entire land-climate system and illustrates how climate change is tightly linked to issues of land degradation, land management and natural resources. From this perspective, the fight against land privatization sheds light on the importance of discussing the multiple social, economic, cultural and environmental rights embedded in land, which are the rights of future generations.

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SYLVIE FANCHETTE*

DELTA VULNERABILITY LINKED TO CLIMATE AND ENVIRONMENTAL CHANGES: METROPOLIZATION CHALLENGES IN ASIAN AND NILE DELTAS

Deltas are low-lying social, political and environmental systems (SPES) characterized by the interplay between rivers, land and oceans and influenced by a combination of riverine and oceanic processes. They are shaped by human intervention in the form of strong water control management policies implemented by the state (Biggs et al. 2009; Fanchette 2006). The political dimension of SPES is central to understanding their dynamics and the settlement of a dense population in a vulnerable environment. They can have a population density ten times higher than the world average, as they offer a wide variety of natural resources (Wong et al. 2014), such as fertile land and water for irrigated and intensive agriculture, fisheries, abundant biodiversity and non-farm activities (Vorosmarty, Syvitski, and Paola 2009). Deltas and coastal areas are among the most dynamic places on earth in terms of urbanization and economic change (Government Office for Science 2011). They benefit from being strategic places for global trade and having high population densities that encourage industry development focusing on export. National economic reforms have restructured economies and increased international and domestic capital inflows to

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delta areas, resulting in the development of world coastal zones. Delta megacities can be found in Asia – Shanghai, Guangdong, Jakarta, Bangkok, Ho Chi Minh City, Kolkata and Dhaka – and in Africa, including Cairo and Alexandria. Two-thirds of metropolises with more than five million inhabitants are located on the coast or in deltas. Approximately 500 million people live in delta areas, despite them representing less than 1 per cent of the earth's surface.

However, deltas are one of the most vulnerable coastal environments. They face a range of threats that climate change is exacerbating, and sea-level rise puts their coastal areas at stake. With sea-level rise and changes in river flows, deltaic cities are exposed to new challenges related to climate change as well as inadequate and short-term urban and hydraulic planning policies. There are contradictions between the growing awareness of the risks of climate-induced flooding in resilient-city plans and the continuation of development practices widely acknowledged to exacerbate those risks (Weinstein, Rumbach, and Sinha 2019). Thus, cities in deltas face a double danger in terms of adverse impacts of climate change: they are a uniquely vulnerable environment and are affected by urban-led development driven by the coastalization of the economy and the increase in population due to migration. Projections warn of dramatic increases in populations prone to chronic flooding and of the potential permanent inundation of densely populated urban areas (Hanson et al. 2011).

In this chapter, I will investigate the contradiction between the growing awareness of risks induced by climate change and the unsustainability of urban management and development policies driven by land and global capital accumulation. I will also highlight the unsuitability of the majority of adaptation policies implemented at global and national levels to mitigate the impact of flooding, increasing the vulnerability of deltaic cities.

DELTAS ARE LARGE ECONOMIC HUBS AND RICE BOWLS

Deltas are among the most populated plains in the Global South, especially in monsoon Asia and Egypt. Asia is home to the world's largest and most populated deltas, created by the sediment deposited by mighty rivers descending from the Himalayas. They are considered the 'rice bowls' of monsoon Asia: the Mekong Delta, for example,

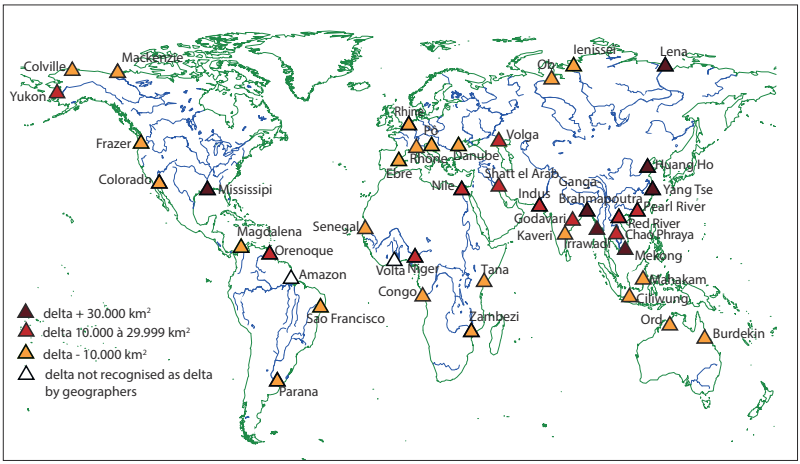

Figure 1. Locations of large and medium deltas in the world. Source: Figure by Sylvie Fanchette.

produces over 50 per cent of Vietnam's food resources. The Ganges Brahmaputra Meghna Delta, commonly called the Bengal Delta, is the largest in the world, shared between Bangladesh and West Bengal in India and hosting 250 million people. Egypt's Nile Delta is medium-sized, although the Nile is the longest river in the world. The population densities in this delta amount to more than 1,600 inhabitants per square kilometre, while the Asian deltas have a density of between 500 and 1,000 inhabitants per square kilometre.

Deltas have played an essential role in human history, serving as cradles of civilization, testing grounds for early agriculture and the birthplace of hydraulic engineering. They therefore offer many opportunities for settlement and economic development. The alluvial deposits brought by their rivers nourish their flat lands, and irrigation is largely developed thanks to a dense hydraulic network and a nearby groundwater table. These lands can bear three cereal crops annually. These outstanding agronomic qualities continually shape these regions, renewing the fertility of the soil each year. The contact between the fresh water of the river, rich in nutritious elements, and the salt water of the sea leads to an abundance of fish and seafood. Deltas have many advantages for artificial irrigation by gravity, thanks to their flat topography, and thus for agricultural intensification,

especially in arid regions like the Nile Delta. Similarly, the shallow water table prevents the clay soil from drying out and allows easy access to groundwater for human consumption and irrigation.

In addition, deltas' position on the great maritime routes integrated them into world trade networks early on (Kaida 2000), which has boosted the economic development of many cities. The dense water system canals facilitated exchanges between cities and the countryside and relationships with the upstream valley. From the beginning, Alexandria was envisioned to be the largest harbour in the Mediterranean region. Delta cities are therefore in a favourable position for sea and river trade, despite the difficulty of developing the sites and protecting their extensions from flooding risks. Indeed, many cities were created on levees, such as Phnom Penh, or rocky spurs, such as Alexandria, and require the construction of polders to expand, which are created by building dykes and filling in low-lying land (Pierdet 2012).

INCREASING VULNERABILITY LINKED TO CLIMATE CHANGE AND UNSUSTAINABLE POLICIES

Deltas are recognized as one of the most vulnerable coastal environments. They face a range of threats operating at multiple scales, from global climate change and sea-level rise to various hazards (floods, erosion, salinization, subsidence), local anthropogenic activities and land-use change. Twenty-four out of thirty-three deltas studied globally are sinking, and 85 per cent have experienced severe flooding during the last decade (Syvitski et al. 2009). They are sinking in part because they are sedimentarily unstable but primarily because pumping groundwater for agriculture, fish farming and urban and industrial areas creates a vacuum. With climate change, the frequency and intensity of these hazards are increasing and are less and less predictable. More than ten million people annually experience flooding due to storm surges alone, and most of these people live in Asian deltas.

MARITIME FLOODING

Maritime flooding has multiple combined causes: the adverse secondary effects of hydraulic developments (dams, dykes, water control) on the reduction of sedimentation, the variation of floods in low-lying

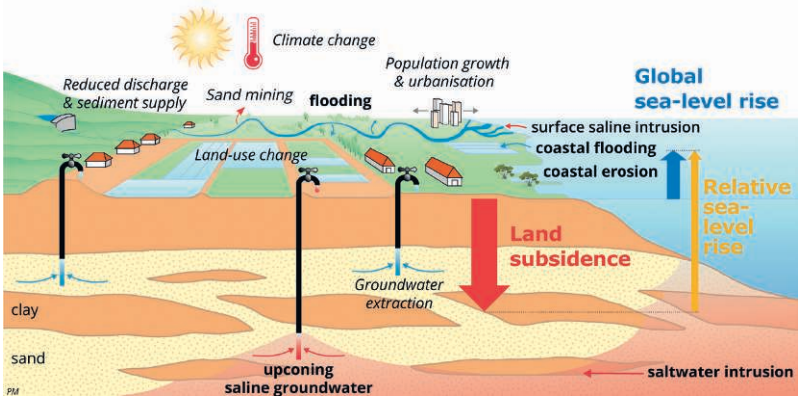

Figure 2. Changes (italic) and consequences (bold) in modern urbanizing deltas. Relative sea-level rise is the combined effect of global sea-level rise and land subsidence. Source: Minderhoud (2019). © CC BY-NC-ND 4.0, no changes made.

areas and the subsidence of deltas. In addition to trapping alluvial deposits, dams reduce riverine inputs to the oceans, weaken deltas in the face of maritime dynamics, jeopardize the fragile alluvial balance at the scale of the plain and the deltaic front and increase coastal and river erosion in addition to saline water intrusion. Soil and water salinization puts agriculture development in the lower deltas at risk. Deltas of extensively dammed rivers are shrinking.

In cities, flooding problems are exacerbated by the paving of land and industrial sprawl at the expense of agricultural areas. This affects the permeability of the soil and its capacity to store and drain water. Similarly, mangroves, site of rich biodiversity where marine and river waters meet, protect coastlines from maritime erosion and form a natural barrier against the effects of swells and storms. With the development of aquaculture and shrimp farming for export as well as beach tourism and deforestation, mangroves are disappearing, threatening the biodiversity of coastal areas. The 2004 tsunami in Thailand caused severe damage mainly because mangroves had disappeared to make way for mass beach tourism.

COASTAL NILE DELTA AT RISK BECAUSE OF SEA-LEVEL RISE AND URBAN MANAGEMENT POLICIES

Egypt is predicted to be one of the top five countries most impacted by climate change. The coastal zone of the Nile Delta is undergoing severe erosion caused by human intervention and non-adapted management. The construction of the Aswan High Dam in 1964 seriously impacted the Nile Delta due to the changed load of water and sediment flow. Today, it is experiencing a high rate of erosion and saline water intrusion. The water mass of the coastal area lagoons has significantly decreased, with a loss of approximately 4,883 square kilometres over twenty-five years, mainly because of the excessive enlargement of fish farms and other aquaculture activities. Other areas were drained and reclaimed for agricultural development. Shoreline erosion along the Nile Delta ranges from ten to twenty-one metres per year, depending on location, time and methodology. The rate of erosion in Alexandria is nearly thirteen metres per year (Ali and El-Magd 2016). This coastal instability is not new. In the seventh and eighth centuries, several cities surrounding the western Nile's Canopic branch – including Canope, Menouthis, Thônis and Heraklion – played an essential role in trade, religious events and leisure. They disappeared beneath the sea due to a series of earthquakes and tidal waves (Goddio and Fabre 2007).

Recent surveys show that the northern delta region is subsiding at a rate ranging from about two millimetres per year in Alexandria to about two-and-a-half millimetres per year in Port Said. The Bay of Aboukir is sinking five to seven millimetres per year. Between 1974 and 2006, the mean sea level in Alexandria increased by 8.09 centimetres, which means a sea-level rise of 2.45 millimetres per year. Coastal flooding will occur with increasing frequency. Thus, urban coastal structures are at considerable risk (Hendy et al. 2021). In absolute terms, Alexandria, Port Said and Edku have the largest built-up areas susceptible to inundation by sea-level rise (Abdrabo and Hassaan 2015).

The proposed extreme Intergovernmental Panel on Climate Change (IPCC) sea-level rise scenario of fifty-nine centimetres coupled with the estimated land subsidence of an average of twenty-five centimetres by this century leads to an estimated sea-level rise of eighty-four centimetres by the year 2100. In this scenario, a large area of the Nile Delta (approximately 2,671 square kilometres) would be

inundated, which means that 10 per cent of the entire area would be directly vulnerable to inundation and saltwater intrusion. This would affect the coastal Nile Delta environment and marine life and force millions of inhabitants to migrate from their homes to save their livelihoods (Ali and El-Magd 2016).

RIVER FLOODING: METROPOLISES AT RISK

Since the early 2000s, natural disasters related to river flooding have intensified in low-lying coastal areas. River flooding combined with cyclones and tide-induced sea flooding severely affects deltas. During monsoon rains in tropical valleys, the flow of river water to the sea slows down and the river overflows. The draining of rainwater is challenging because of the many obstacles erected in its way (roads, buildings and so on). Changes in land use, from flooded or irrigated rice fields to paved and impermeable land, limits the natural drainage of rainwater.

These trends will only increase, placing more people and assets at risk as sea levels rise in large metropolises and their precarious neighbourhoods are located in flood-prone areas. Some deltas, such as the Indus Delta in Pakistan, have reached a tipping point. Tipping points are defined as reaching the Anthropocene 'collapse', in which society is no longer capable of protecting (part of) a delta because of uncontrolled or unmitigated forces, including the social, political and ecological forces which are part of the SPES (Renaud et al. 2013).

UNSUSTAINABLE DEVELOPMENT OF DELTAIC CITIES AND ENVIRONMENTALLY DESTRUCTIVE PRACTICES

Until the colonial era, the great old port cities of Europe and Asia were protected from the open sea by bays, estuaries or deltaic river systems. 'It is as if, before the early modern era, there had existed a general acceptance that provision had to be made for the unpredictable furies of the ocean – tsunamis, storm surges, and the like' (Ghosh 2016, 37). After the seventeenth century, colonial cities were erected on seafronts around the world. These cities, all brought into being by colonization, are now among those most directly threatened by climate change (Ghosh 2016, 37).

Export-led industries are developing near large harbours, increasing the process of coastalization of the economies and fuelling the

migration of workers from remote areas. Thus, the number of people and assets affected by floods related to globalization and climate change is increasing, as is their exposure to these risks.

Deltaic metropolises expand rapidly, taking environmentally unsustainable land-use planning paths. They represent an extraordinary and unique 'concentration of risk' (Ghosh 2016). The floods in Thailand's Chao Phraya Delta in 2011 showed the fragility of the country's economy, which is concentrated in the Bangkok metropolitan area that at the time housed 75 per cent of the country's urban population and produced 50 per cent of its GDP (Pierdet 2012). The impacts of climate change are likely to be more harmful in urban areas, since the latter are exposed to additional risks linked to increasing socio-economic disparities (social and spatial fragmentation, growing inequality, land pressure in the city centre, urban sprawl, multiplication of informal neighbourhoods relegated to the outskirts or areas at risk, etc.). These factors certainly increase the physical but above all the social vulnerability of delta regions, which is likely to be further exacerbated by climate change (Quenault 2013).

The expansion of cities into their low-lying margins adds to the risk of flooding and poses many problems:

- A dense hydraulic network for field irrigation criss-crosses cities' peripheries. Urban expansion necessitates a redesign of this hydraulic system as agricultural land becomes building land: polders have to be created, which are dammed and filled in with a drainage system made of canals, locks and pumping stations.
- Towns and villages extend into fields and rural outskirts, and the construction of large motorways is carried out with a great deal of embankment but at the cost of flooding the villages. These constructions constitute obstacles to water flow when the basin is exposed to flooding, and the water stagnates for weeks (Bravard 2019).
- The risk of floods increases in 'sinking' deltaic cities.

Delta cities are subject to many development challenges, and subsidence is one of the most pressing. Land subsidence has several causes, including natural compaction of soil and compaction caused by buildings and infrastructure. However, the main driver in many cities is groundwater extraction for use by households and industry (Ward et al. 2011).

Competition for water between industries and growing household demand is intense, and groundwater supply appears to be an easy solution. The water distribution system is sometimes old and not well adapted to the growing demand of new neighbourhoods. Installing pipe-water distribution systems is expensive and raises the question of the fate/destiny of unregistered land that local governments do not want to develop.[1] In parts of Bangkok, land subsidence rates have reached up to ten centimetres annually, while in Jakarta, figures as high as twenty-six centimetres per year were recorded in parts of the city (Abidin et al. 2011). The adverse effects of coastal cities' subsidence are numerous: faster relative sea-level rise due to the sinking of the coast, difficulty in evacuating drainage water, damage of distribution and traffic networks and the destruction of buildings and assets.

Several disasters have struck in this century as a result of these issues: in 2011, catastrophic floods occurred in and around Bangkok following five to six months of intense rainfall. In Jakarta, floods caused by heavy rains and the destruction of dykes in 2007 displaced more than half a million people and closed many roads, railways, motorways, telephone lines and the international airport, paralysing the region (Texier, Lavigne, and Fort 2010).

URBAN RISK ASSESSMENT PLANS AND THEIR IMPLEMENTATION

Numerous coastal metropolises have implemented plans to better respond and adapt to hazards, including those induced by climate change. The World Bank and other international organization help governments implement urban risk assessments and climate-friendly city plans (Dickson et al. 2022). The 100 Resilient Cities project, pioneered by the Rockefeller Foundation, 'help[s] more cities build resilience to the physical, social, and economic challenges that are a growing part of the 21st century' (Rockefeller Foundation n.d.). However, while these plans acknowledge a city's climate-induced challenges, they still focus on development-driven economic growth. These practices exacerbate floods and flood losses, facilitated by increasing land consumption

1. In Jakarta, more than 3,700 deep wells have been drilled by residents in most low- and moderate-income settlements (Shatkin 2019).

(Weinstein, Rumbach, and Sinha 2019). Thus, as mentioned in the introduction, there are contradictions between the growing awareness of climate-induced flooding risks in resilience plans and the continuation of development practices widely acknowledged to exacerbate those risks (Weinstein, Rumbach, and Sinha 2019).

In Kolkata's Bengal Delta region, the city and regional governments have produced several plans aimed at helping the city mitigate flooding and adapt to future environmental change. Despite their acknowledgement of the ecologically harmful impacts of current development practices in low-lying and ecologically sensitive areas, these governments demonstrate continued support for real estate-led development. Weinstein, Rumbach and Sinha (2019) highlight three factors:

- Most new construction happens outside of official planning documents, for elites as well as for the poor, and laws are routinely suspended to further elite interests.
- City officials appear more focused on 'less fancy' but 'more urgent' issues than flood risk reduction, such as housing and real estate development.
- Cities may adopt the language of 'resilience' in high-level plans and strategy statements, but their own approach to climate resilience is deeply invested in and directed by a real-estate-driven economic growth model.

Finally, large development projects such as fish farms are not sustainable, neither environmentally nor socially. However, aquaculture has strongly developed in Nile Delta coast to meet the growing demand for seafood and animal protein. Between 1990 and 2014, the region's fish farming area expanded from 81 square kilometres to 937 square kilometres, at the expense of water bodies and coastal dunes. The Nile Delta coast was initially occupied by a strip of dunes and land forms that separated the Mediterranean Sea from the inland of the Nile Delta. They played a role in maintaining the ecological balance and worked as an intermediate shelter zone between marine and terrestrial environments (Ali and El-Magd 2016). Moreover, large projects and highly industrialized farms are managed by foreign companies and provide few jobs locally, leading to the emigration

of the local population due to a lack of jobs. These projects are also unsustainable because they erase very fertile land and pump up groundwater (depleting the table); thus, they increase the subsidence of coastal areas.

HOW DELTAIC CITIES CAN ADAPT OR MALADAPT TO ENVIRONMENTAL CHANGES LINKED TO CLIMATE CHANGE

Deltas are dynamic systems where communities have a long record of adapting to natural hazards, living with floods and becoming accustomed to being highly exposed to environmental risks. In Asia, states and international agencies have strongly invested in water management to protect the population and territory from multiple dangers (floods and storm surges) by building hard technological infrastructure (dams, dykes, polders) and setting up early warning systems. For centuries these populations have developed a range of strategies and practices.

Cities currently face the double challenge of mitigating their high greenhouse gas (GHG) emissions and developing adaptive measures. Deltaic societies and their systems of governance and organization have extensive experience in anticipating risks such as floods and cyclones and coping with and adapting to risk. Nevertheless, climate change, along with other drivers of global economic change, poses novel risks often beyond their range of experience (Klein et al. 2014). Moreover, their resilience to ongoing environmental climate change is challenged by increased socio-economic inequalities, the asymmetry of power in these societies and their inability to respond to external stresses (Adger, Safra de Campos, and Mortreux 2018).

Potential measures to help deltaic communities and their environments adapt to the impacts of climate change, especially in cities, are multiple and can be technical and physical, social and organizational. They essentially depend on states' wealth and their modes of governance (democratic or authoritarian), the role and power of their civil society and their historical experience and assessment of risk. Various types of adaptation strategies are implemented at several levels and can be combined. They highlight the importance of local governance and community involvement and participation.

- Hard-engineering protective measures are most commonly used to reduce coastal flooding and erosion, as seen with the construc-

tion of sea walls on the Nile Delta coastline, projects to dam up bays in Jakarta's great Garuda Project or polders, as used in Dhaka and Phnom Penh. These measures have raised contentious questions about their high cost, effectiveness, ecological effects and social impacts on communities residing along the coast. Also, hard protection is not an affordable long-term solution for most countries in the Global South (Haasnoot, Lawrence, and Magnan 2021). Many experts are sceptical about attempts to reduce risk by hazard control alone (Tabet and Fanning 2012; Weinstein, Rumbach, and Sinha 2019; Du et al. 2020). Dykes give a false sense of control and security and increase the potential exposure of the many people living nearby. In the Nile Delta, despite the availability of a wide range of alternatives to deal with the retreating shoreline, only 'hard' adaptation options – such as the construction of breakwaters, dykes and jetties – have been used to control shoreline erosion (Abdrabo and Hassaan 2015). Even though the coastal erosion of the Nile Delta persisted with this infrastructure in place (Ali and El-Magd 2016), the Green Climate Fund (GCF) continues to implement hard-engineering options. Sixty-nine kilometres of sand dune dykes will be installed in five vulnerable hotspots within the Nile Delta.

- Combining hard-engineering measures with nature-based solutions, spatial planning and early-warning systems can help contain residual risk (Du et al. 2020). Nevertheless, there are limits to this strategy in terms of its environmental impacts and costs and the availability of potential and permitted sand reserves, which may be unable to keep up with higher rates of sea-level rise.
- Which adjustments communities implement is determined in part by their ability to act collectively, their social capital, their knowledge of the risks involved, their vulnerability (social, economic, environmental) and the policy of adaptation implemented by local or national authorities. In deltas, famers adapt their cropping pattern to floods and salinity intrusion by diversifying, mixing aquaculture and rice. This is done in parallel with water management and disaster risk management. With the help of NGOs and associations, communities and local authorities have initiated early-warning systems as well as micro-credit and micro-insurance systems.

Environmental migration is one of the structuring elements of deltaic SPES. Given that the delta settlement process has involved land reclamation and water control for thousands of years, combined with the population's high vulnerability to various types of floods and hazards, mobility has become systematic for many delta residents. Migration can be considered one of many interrelated adaptation strategies for affected populations. However, the latter rely on translocal networks and practices across multiple places within and beyond deltas.

- Accommodation measures include the elevation or flood-proofing of houses and other infrastructure, spatial planning, amphibious building designs following a *sponge city* pattern, increasing water storage or drainage capacity and slum upgrading. Raising land or buildings (on stilts) could avert flooding and be accomplished artificially. At a medium scale, a government may implement nature-based interventions through river diversion (Haasnoot, Lawrence, and Magnan 2021).
- Among the many adverse impacts of climate change in the most vulnerable countries, climate-change-induced displacement caused by extreme weather events is an increasingly serious concern, particularly in densely populated Asian countries (Alam et al. 2018). Bangladesh is the most vulnerable: 4.1 million people were displaced as a result of climate disasters in 2019 (2.5 per cent of the population) (Khan et al. 2021). Retreat is a strategy to reduce exposure and eventually the risks facing coastal cities by moving people, assets and activities out of coastal hazard zones. It includes adaptive migration, involuntary displacement and the planned relocation of populations and assets from the coast. However, implementing a managed retreat constitutes a multidecadal sequence of actions, including community engagement, a vulnerability assessment, land-use planning, active retreat, compensation and repurposing (Haasnoot, Lawrence, and Magnan 2021). Building climate-resilient, migrant-friendly cities and towns in Bangladesh has become an urgent need to tackle the adverse effects of climate change. Infrastructure which can not only absorb shocks but also attract rural populations by providing services and livelihood opportunities will ease the population pressure on major cities (Khan et al. 2021).

ADAPTATION GOVERNANCE CHANGES: THE CASE OF EGYPT

'An array of climatic and non-climatic perils … present coastal communities and their governing authorities with immense governance and institutional challenges that will become progressively more difficult as sea level rises [sic]' (Glavovic et al. 2022, 2177). In order to overcome these challenges, various countries highly impacted by climate change have been implementing projects and plans with the support of international agencies for the last one or two decades. The GCF collects USD 100 billion a year from Western countries with a high historical level of GHG emissions. In Egypt, this fund is co-financing a project with the United Nations Development Programme (UNDP) called 'Enhancing climate change adaptation in the North Coast and Nile Delta Regions in Egypt 2018–2025'. The USD 100 million project aims to reduce coastal flooding risks on Egypt's north coast and finance hard-engineering defences. An integrated coastal zone management (ICZM) plan has been developed for the entire north coast to manage long-term climate change risks and provide Egypt with adaptability to impending flood risks (Green Climate Fund n.d.). However, the institutional context of the Nile Delta's coastal urban areas suffers from several shortcomings. A lack of vertical and horizontal integration reveals gaps between and conflicting positions of governing bodies and affects the proper development of the plan. The mode of governance of these government bodies is characterized by centralization and limited participatory practices (Tabet and Fanning 2012).

In addition, the government developed a National Strategy for Adaptation to Climate Change and Disaster Risk Reduction in 2015, which proposes actions to increase the population's resilience and enhancing community participation at all levels. However, the plan does not propose any specific measures to be adopted. The current institutional setting and coastal zone governance mechanisms involve limited institutional contributions to urban resilience in the Nile Delta (Abdrabo and Hassaan 2015). According to the last IPCC report (Glavovic et al. 2022), few infrastructural or adaptation plans for urban areas are being developed through consultation and co-production with diverse and marginalized urban communities.

Finally, unlike monsoon cities, Alexandria does not suffer from regular floods. However, in 2015, severe rainfall events caused flooding

in the city and its neighbouring region, leading to casualties. Activities stopped for two weeks, leading to EUR 25 million in damages (IHE 2017). A project called Anticipatory Flood Risk Management (AFMA) was set up with the help of the Netherlands in order to understand the flood risk facing Egyptian cities and the possibility of an increase in the frequency of events. It aims to better prepare the region for extreme rainfall events, creating a design for the exceedance of urban drainage systems (IHE 2017).

The different adaptation strategies presented above can be combined in different contexts. However, they would benefit from citizen participation, drawing on local knowledge of adaptation to risk, from a socio-economic vulnerability assessment of the population exposed to these hazards and from an assessment of the population's and local stakeholders' perception of risk. 'Bottom-up' insights are more accurate than options that are deterministic and one-size-fits-all and encourage binary 'migrate or not' decisions (Horton et al. 2021). Thus, these strategies should not rely on climate risk assessments based on top-down approaches and international assumptions.

CONCLUSION

Most large metropolises built during the colonial era are located on coasts. As stated, deltas and coastal areas are among the most dynamic places on earth regarding urbanization and economic change. They benefit from strategically appealing locations in terms of global trade and high population densities for industry development. However, they are at the forefront of climate change and sea-level rise and represent an extraordinary and unique concentration of risk. They are increasingly exposed to floods linked to environmentally unsustainable land-use planning, urban sprawl on low-lying land and climate-change-related adverse impacts.

Thus, governments must overcome the double challenge of mitigating their GHG emissions and developing adaptive measures to deal with the adverse impacts of climate change. The implementation of these measures depends on states' wealth and their modes of governance, the role and power of civil society and their historical experience and assessment of risk.

In order to better adapt strategies to existing needs, countries are initiating climate risk assessments usually based on 'top-down' approaches. They privilege strategies based on physical sciences over understandings of local vulnerability and adaptive capacity informed by the social sciences. So far, adaptation solutions have been technical as opposed to nature- or accommodation-based. However, hard protection is not an affordable long-term solution for most countries of the Global South and it fails to address many technical, environmental and social problems affecting coastal communities. Governance adapted to the local and environmental context is a key solution.

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FLORIAN BONNEFOI*

ADAPTING TO CLIMATE CHANGE: FOR A SOCIAL APPROACH TO COASTAL DEFENCE STRUCTURES IN THE NILE DELTA

INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) identified deltas as being among the areas most vulnerable to climate change (IPCC 2022). Indeed, low-lying deltaic coasts are particularly vulnerable to flooding. The coast of the Nile Delta in Egypt extends over 225 kilometres between Port Said and Alexandria. It is bordered by four lakes, 'the four sisters', which form lagoons: Lake Manzala, Lake Borollus, Lake Edku and Lake Mariout. Since the construction of the Aswan High Dam in the 1970s, the risk of river flooding has been under control. However, in the context of global climate change, concern has shifted to a potential increase in sea level. According to estimates, between 15 and 25 per cent of the Delta could be submerged if the Mediterranean rises between half a metre and a metre by 2100. The risk of submergence is reinforced by the natural dynamics of subsidence and coastal erosion linked to a lack of sediment supply, which remains blocked by the Aswan Dam. Only 9 per cent of deltas in the world are in a regression phase.

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This is the case for the Nile Delta as well (Nienhuis et al. 2020), although it is not homogeneously vulnerable to climate change. A distinction must be made between global and relative sea-level rises, which depend on the characteristics of each coastal region. In Egypt, the eastern part of the Delta is more vulnerable because it is subject to more pronounced subsidence. The governorates most at risk are Port Said, Damietta and Kafr el-Sheikh. More locally, the two promontories of Damietta and Rosetta are particularly at risk (Frihy and Lawrence 2004). Generally though, the entire coast is vulnerable and appears to be a hotspot of climate change in Egypt and in the Mediterranean basin.

Risks result from a meeting between a hazard and human vulnerability (Pigeon 2005). The Nile Delta is characterized by an uncommon demography. Indeed, half of Egypt's population – nearly 50 million people – lives in the region in high-density conditions, which differentiates this delta from other deltas in the world (Fanchette 2014). The northern Egyptian coast represents a strategic territory occupied by several ports and large cities, foremost among which is Alexandria. Continued urbanization not only increases vulnerability but is also a driver of global climate change. Fishing villages are also scattered along the coast and bear the full brunt of the ongoing environmental

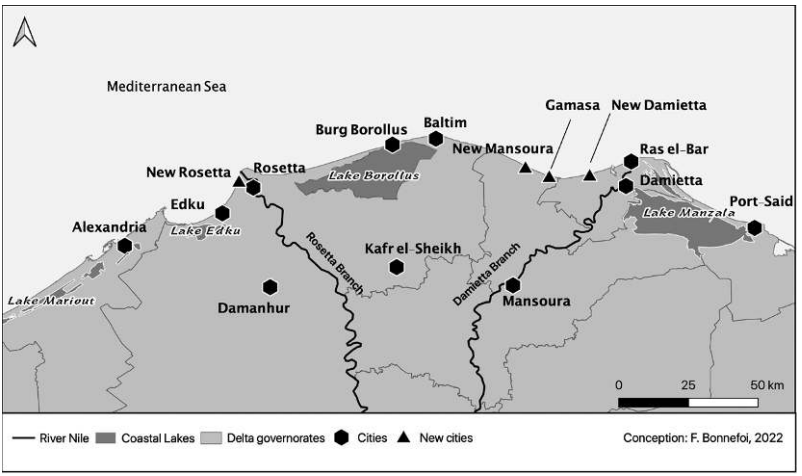

Figure 1. The Nile Delta: A very urbanized area. Source: Florian Bonnefoi, 2022.

degradation (Malm and Esmailian 2012). Authorities have focused on adaptation more than mitigation. Since the 1990s, successive governments have made the political and social choice of adaptation through hard structures: jetties, dykes, breakwaters and concrete blocks have gradually colonized the northern Egyptian coast. They have imposed themselves on the landscape but also on the daily practices of coastal areas and are the symbol and embodiment of environmental and climatic risks. At the same time, they are a reminder of human responsibility for and vulnerability to these risks. However, they are gradually being appropriated by political and economic actors as well as city dwellers to the point that we are witnessing a departure from their initial function of protection.

One may then ask to what extent the multiplication of coastal defence structures on the Delta seashore tends to alert us to current and future dangers and at the same time, tend to trivializes the environmental and climatic risk. This chapter will first review this highly urbanized deltaic coast's vulnerability to environmental and climate change. It will then discuss these adaptations that have taken the form of hard structures, leading to a concrete landscape that has become an interface between the sea and human society. Finally, it will look at the daily practices of these spaces and question their impact on the social vulnerability of the Nile Delta coast.

A PARTICULARLY VULNERABLE URBANIZED COASTLINE

A DENSELY POPULATED STRATEGIC AREA

With 104 million inhabitants in 2022, Egypt is a demographic giant in the Mediterranean basin and in the Arab world. The Delta region is home to half of its national population and has extremely high densities of up to 1,600 people per square kilometre in rural areas. It is far removed from the image of the eternal countryside as it is home to several large cities, especially on the coast. Indeed, the region is now home to five of Egypt's ten most populous cities: Alexandria, Port Said, Tanta, Mansoura and El-Mahalla el-Kubra. The dynamics of urbanization, which began in the post-war era, continue to intensify, making the Delta an emblematic territory of 'planetary urbanization' (Ruddick et al. 2017) and of the Anthropocene. Researchers have

called it an 'Ecoumenopolis' (Denis 2007). More and more land is being nibbled away by urbanization every year, challenging one of the planetary limits (Steffen et al. 2015), namely land-use change. Of the Delta's fertile land, 74,600 hectares were lost between 1992 and 2015. Over this period, the built-up area increased from 755 to 1,890 square kilometres, with an average annual growth of 47 square kilometres (Radwan et al. 2019). To put this into perspective, this increase represents an area equivalent to the city of Berlin. The coast is not spared. In fact, urbanization is coupled with strong littoralization dynamics, following the worldwide preference of people to settle in coastal areas, which are attractive in terms of economy and living environment.

Regarding the Egyptian Nile Delta, this urbanization is very ancient and dates back to the Pharaonic era. Alexandria was founded in 331 BC by Alexander the Great. Today, the urbanization process continues with two concomitant dynamics. On the one hand, existing cities are extending through urban sprawl, via either government-led development projects or informal settlements. On the other hand, new cities are being created directly on the coast. One recent example is New Mansoura, which was started in 2017. It is being built in the dunes, on the international road between Lake Manzala and Lake Borollus. Images that the government and real estate developers posted on social media show the construction boom this area has undergone since the beginning of the project.

Urbanization is leading to the increased artificialization of land and the coast, which has a double disadvantage. On the one hand, the disappearance of the vegetation cover accelerates temperature increases. Thus, the transition from agricultural to urbanized land likely produced a temperature increase of 1.7 °C in the areas concerned (Hereher 2017). In cities, the phenomenon of heat islands is particularly important and leads to a vicious circle: air conditioning is used to lower temperatures inside buildings, consuming large quantities of energy and leading to a rise in outside temperatures. In Alexandria, for example, electricity consumption, which has been steadily increasing over the past ten years, could increase exponentially by 2050. It is estimated that 50 per cent of the city's electricity consumption comes from residential areas, and it has grown 6.7 per cent annually between 2010 and 2016. Population growth alone is not

responsible for this increase. This consumption is subject to strong seasonal variations and, since summer temperatures could significantly increase by 2050, we can expect another surge in the coming years. In this sense, global warming represents an additional pressure on energy demand and consumption (Abdrabo, Hassaan, and Abdelraouf 2018). Another disadvantage of the increased artificialization of the coast is that increasing numbers of people and activities are exposed to risks. Their settlement in these areas seems counter-intuitive, although it is a worldwide dynamic.

COASTAL CITIES PARTICULARLY VULNERABLE TO CLIMATE CHANGE

Cities play the role of drivers and amplifiers of climate change but are also very vulnerable. Cities of the Delta, first and foremost the coastal cities, are exposed to climate risk in its different forms, whether an increase in sea level or storms (Abdeldayem et al. 2020). The extreme littoralization of people and activities accentuates the magnitude of losses in case of floods. For instance, in Alexandria, average annual economic losses due to flooding between 2005 and 2050 will be the highest worldwide. They could increase by 154 per cent between these two dates (Hallegatte et al. 2013). Alexandria is the second largest city in the country, with almost 5.1 million official inhabitants according to the 2017 census. The city is densely built and highly vulnerable to sea-level rise, as 37 per cent of its buildings are located less than one kilometre from the shore (El-Hattab, Mohamed, and El Raey 2018). Without protection, a fifty-centimetre sea-level rise would be enough to displace two million people and threaten 214,000 jobs (Redeker and Kantoush 2014). Furthermore, the city is home to 40 per cent of the country's industries, which, in addition to the economic implications, could lead to an industrial disaster in case of flooding.

Other major and secondary cities are located on the seashore and could suffer heavy losses. These include Port Said, Damietta, Gamasa, Baltim, Rosetta and Edku. Their inhabitants are experiencing increasingly frequent and intense sea storms that result in flooding. Coupled with run-off floods linked to the artificialization of the soil, these floods challenge the sewage systems, cause buildings to collapse and kill people. The storm of December 2010 was particularly violent: in Alexandria, four buildings collapsed within forty-eight

hours and about thirty people died. In October 2015, the city experienced heavy rainfall (thirty-two millimetres in a few hours). The city's drainage system was unable to redirect the rainwater to the sea. Many neighbourhoods were flooded – 30 per cent of the total urban area – transportation was stopped for several days, electricity was cut and seven people were electrocuted (Zevenbergen and Salinas Rodriguez 2017). Alexandria's vulnerability is heightened by its location: wedged between the Mediterranean Sea and Lake Mariout and stretching over some fifty kilometres. Coastal villages are also particularly vulnerable, especially since in their case, the environmental risk accentuates their pre-existing economic and social vulnerability.

A CONCRETE COAST: TOWARDS A NEW NATURE–SOCIETY INTERFACE?

BENEFITS AND DISADVANTAGES OF ENGINEERING STRUCTURES

Faced with these increased risks and vulnerabilities, the Egyptian government has implemented a variety of heavy infrastructure projects to protect the coast from the onslaught of waves and the rising sea. It has done so through the Egyptian General Authority for Beach Protection that is attached to the Ministry of Irrigation and Water Resources. Among these are structures perpendicular to the shoreline, such as *groin fields* used to maintain beaches and to limit longshore sediment transport and *jetties* that aim at minimizing sediment deposition, especially in harbours. Other are parallel to the shoreline, including *breakwaters* – offshore structures made of rock or concrete that break waves – *sea walls*, which reduce the impact of waves and thus of erosion, and *revetments made of concrete blocks*. These structures form a defensive front against erosion and the effects of climate change. They can be seen in many coastal cities, including in Alexandria, Burg Borollus, Baltim and Ras el-Bar. The implementation of these developments on the coast is not a novelty related to current climate change, but began as early as the nineteenth century during the reign of Mohammed Ali. The first dyke was built in Alexandria in 1830, and construction continued during the twentieth century with structures in Ras el-Bar in 1941, on the Rosetta promontory in 1989–1991, and elsewhere. These structures are therefore the result of a deliberate

Figures 2a. Coastal defence structures: offshore breakwaters in Ras el-Bar. Source: F. Bonnefoi, March and April 2021.

planning tradition, partly dictated by the fragile and unstable geography of the Delta.

Although they appear to be effective short- and mid-term defences against the effects of climate change, these defences are not a miracle solution and also have perverse effects. First of all, the construction of these structures is costly in terms of greenhouse gas (GHG) emissions. Indeed, the concrete that composes them is made from cement, the production of which requires the burning of fossil fuels. Cement production is responsible for 7 per cent of annual CO_2 emissions worldwide (Fennell, Davis, and Mohammed 2021). Moreover, they address only one facet of the problem. Indeed, while they are relatively effective in stopping waves and limiting the risk of marine submersion, they do not address the issue of saltwater intrusion. The latter extends several tens of kilometres inland. On the coast of Kafr el-Sheikh and Beheira for example, this intrusion suffocates palm trees and thus endangers the livelihood and living conditions of farmers. In addition, sea walls tend to accelerate erosion on adjacent beaches and at the toe

Figures 2b. Coastal defence structures: concrete blocks in Alexandria. Source: F. Bonnefoi, March and April 2021.

of the wall. These heavy structures also harm biodiversity. These disadvantages are why experts often promote nature-based solutions. Green buffers such as dunes are natural barriers against erosion and sea-level rise. Experiments with these are underway in Egypt. For example, a dune restoration programme is being carried out in New Damietta.

TOWARDS A COASTAL LANDSCAPE OF CONCRETE

Coastal defence structures have profoundly modified coastal and urban landscapes. For example, in Alexandria, up to ten rows of concrete blocks sit in the sea, forming a buffer of about fifteen metres between the Corniche and the waves. This buffer extends along almost the entire Alexandrian coastline, from Manshiyet Bay in the city centre to Montazah Park twenty kilometres away. However, to think that the Alexandrian coastline was 'natural' before these blocks were put into place is an illusion. Instead, it has been constantly modified since the nineteenth century. For example, the Corniche along Manshiyet Bay was designed by Italian architect Pietro Avoscani in the 1870s.

Nearly 526,000 square metres of land were reclaimed from the sea. The Corniche was then extended to the north-east and widened several times during the twentieth century. Nevertheless, the protection measures currently implemented constitute a new stage in the anthropization of the coast. The landscape is losing its natural character and a new interface between the sea and the city, between nature and human society, is gradually being established. There is no more direct access to the sea. Concrete blocks have replaced the beach, which is reduced to a few minimal stretches that are accessible to paying guests only. The blocks play the role of mediators and are hybrid objects (Latour 2006) that crystallize the relations of the city with its natural environment and of its inhabitants with the risk of flooding.

However, one can wonder whether these engineered structures are more than a form of adaptation aimed at protecting human installations and whether they also have a performative dimension of making citizens aware of climate risks. They materialize the risk of flooding and submersion, making it more tangible. In brief, they are a constant reminder of danger and vulnerability. Thus, in a certain way, they could participate more or less latently in the diffusion of a culture of risk or at least of awareness. In the words of Bruno Latour (2006), dykes, blocks and jetties embody the end of the great division between nature and culture. They remind us of our vulnerability to the natural elements. They are also a reminder that the risks to which we are currently exposed are largely of our own making.

SOCIAL PRACTICES OF CONCRETE BLOCKS

A RENEWAL OF VALUES ASSOCIATED WITH RISK?

These coastal defence structures were conceived, designed and implemented according to a top-down logic. However, their location at the sea–city interface, i.e. at the heart of the economic activities of trade and fishing and of recreational practices, makes them an everyday space that economic private actors and city dwellers are gradually appropriating. They are the scene of new daily practices and social activities.

As spaces with amenities, particularly sea views, urban waterfronts attract investors. Different actors have hijacked them to turn them into spaces of leisure.

A striking example is the tip of the promontory where the Damietta branch of the Nile flows into the Mediterranean at Ras el-Bar. In June 2019, a new, 158-room luxury hotel from the Steigenberger brand opened in this location. It completely privatizes the left bank of the estuary, which is now occupied by a swimming pool, leaving room for only a narrow pier that leads to the lighthouse. Along the coast, the dykes are occupied by cafes and restaurants. This corresponds to a common dynamic of tertiarization of coastal areas linked to their touristic development. The same thing can be observed in Alexandria. In the San Stefano district, the Gleembay complex located on a dyke extends about 300 metres into the sea. Previously a place for walking, the pier is now colonized by big restaurant and cafe chains, emblematic of the generic places of globalization such as Costa or Starbucks. It has become a place of consumption where prices limit accessibility to the middle and upper classes. In these cases, the protective function of these structures loses visibility in the face of a new recreational function in line with the neoliberal city. More generally, this accompanies the privatization of the seafront, where the beaches, even the public ones, now almost all charge entry fees.

However, ordinary city dwellers are not passive and are also reclaiming and reappropriating these spaces (Berry-Chikhaoui and Deboulet 2000). Deprived of the beaches, which have been replaced by ledges, roads and protection structures, they reoccupy the concrete blocks. In Alexandria, people go there to stroll, meet friends, or eat ice cream facing the sea. Amateur fishermen take advantage of the blocks, which trap some fish. These 'infrastructure-interfaces' become new public spaces. Indeed, they compensate for the lack of urban public spaces that are accessible to all and free of charge. This lack has been emphasized repeatedly for the case of Cairo, but much less so for provincial cities. However, it is just as glaring in the latter. In Alexandria, places where one can stop and sit – such as Ahmed Ourabi Square or Saad Zaghloul Square – are a little more numerous than in the capital. However, parks charge an entry fee and are few in number. Residents tend to occupy any available space, even if it means diverting it from its initial function. This trend seems to be less pronounced in cities with more freely accessible public spaces. For

Figure 3. Occupation of the promontory of Damietta by a luxury hotel. Source: F. Bonnefoi, March 2021.

example, in Ras el-Bar, where the Nile River promenade and large sandy beaches are accessible, fewer people are seen sitting and relaxing on coastal defence structures.

The appropriation of protection infrastructure for leisure purposes leads to a reversal of the values and emotions linked to these spaces: whereas at first they evoked mistrust, even fear, regarding the future, they now take on a much more positive dimension linked to entertainment, relaxation and a carpe-diem type of enjoyment.

INCREASED VULNERABILITY?

Instead of alerting us to risks, these engineering structures can have the opposite effect and give the impression of safety. The use of hard structures seeks to (re)make people into the 'masters and possessors of nature', to quote *Discourse on the Method* by Descartes. It provides an illusion of control and spreads the idea that one could be free from the constraints of natural elements and the climate. One might then ask whether these structures, when implemented alone, lead to a form of

Figure 4. Appropriation of concrete blocks by city dwellers on the Corniche of Alexandria. Source: F. Bonnefoi, May 2022.

maladaptation (Magnan et al. 2016). The IPCC defines maladaptation as 'actions that lead to increased vulnerability or risk to climate impacts or [that] diminish welfare' (2022, 937) and as 'a consequence of failure to address root causes of vulnerabilities' (1189). In other words, it is an attempt to adapt that produces unwanted and undesirable effects.

Two main perverse effects of these defence structures can be identified. The first, mentioned above, is the diffusion of a feeling of security that leads to increased frequentation of the coastline and its development for settlement. These structures make vulnerable areas attractive. Low-lying coastal areas, particularly deltaic ones, will be the first to be affected by any increase in sea levels. Therefore, their continued anthropization and concrete development are dangerous.

On another note, these structures raise questions of equity and environmental justice. The construction of dykes requires technical know-how and financial resources. However, these resources are not equally distributed, and some populations and activities are privileged over others. Andreas Malm (2013) underlines the classist violence of

Figures 5a and 5b. Protection of the citadel of Qaitbay in Alexandria. Source: F. Bonnefoi, May 2022.

climate change, meaning that any intervention is neither politically nor socially neutral. The proposed solutions are very often based on the market economy and reinforce inequalities. Large cities are preferred, first and foremost Alexandria, but also resorts such as Ras el-Bar, where eight breakwaters were built 400 metres from the shore in the 1990s. The resort is better protected than the surrounding villages. In cities, the preferred sites seem to be those that can generate profits through tourism. Thus, in Alexandria, the citadel of Qaitbay has been the subject of a EGP 267 million protection programme. The project includes the construction of a jetty to recreate a beach through the accumulation of sediment, a bridge with Mameluke-style towers, stone blocks that will enclose the bay, and a marina.

Moreover, these structures address the consequences, not causes, of environmental degradation. While they are effective in the short term, their long-term efficiency is more uncertain. They also tend to displace the effects: by creating accretion zones, for example, jetties reinforce the erosion of adjacent coasts. Whereas the main cities and economically strategic places will be protected, secondary villages are increasingly vulnerable.

CONCLUSION

Although coastlines are increasingly vulnerable to the effects of climate change, the urbanization of the Egyptian deltaic coast continues at a steady pace. It accentuates ongoing environmental and climatic changes, causing various types of pollution and the appearance of heat islands as well as increasing soil sealing, increasing the risk of flooding by run-off. It also leads to population concentrations in areas at risk, especially in the face of rising seas. In this context, protective structures are increasingly transforming the coastal landscape of the Delta. The sand gradually gives way to concrete blocks that become an interface between the sea and the land, between the waves and inhabitants. They are a striking example of hybrid objects that reinterrogate the relationship between nature and culture in the era of global climate change. They question the capacity of authorities to implement sustainable solutions to climate risk. They have proven to be effective in the short term, stopping the erosion of the coastline and thus giving a sense of security. Nevertheless, they are only a stopgap measure that increases

vulnerability in the long term. They must be accompanied by other, less invasive measures such as nature-based solutions and, above all, by an in-depth reflection on land-use planning. The increasing anthropization of the coastline magnifies vulnerabilities and potential future losses. Without reflection on their social impacts, coastal defence structures lead to the marginalization and endangerment of the most disadvantaged. While coastal urbanization cannot be stopped easily, especially in a world that operates following a model of economic extraversion and globalization, the population's awareness of environmental issues must be increased in order to generate a real culture of risk and adaptation capacities at the individual and institutional levels. Protecting cities appears to be a priority, especially since climate change is pushing people towards urban centres on a global scale (Adger et al. 2020). This leads to a vicious circle in which vulnerable populations move to centres that are themselves exposed to climatic hazards, thus increasing the vulnerability of individuals and urban infrastructure.

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DALILA GHODBANE*

BUILDING CLIMATE RESILIENCE, LITERALLY: LEARNING FROM HOW HOUSEHOLDS RENOVATE IN CAIRO

INTRODUCTION

France, June 2022. Like every year during this season, the Roland Garros international tennis competition is being broadcast live on television. In the middle of the semi-final match, a young woman, barely in her twenties, enters the centre court, runs towards the net and ties her neck to it. The picture made the rounds in the press. She is seen sitting on her heels, knees on the ground, chest out, chin up, staring into the distance. On her white T-shirt, it says: 'We have 1028 days left' (to act against and limit the effects of global warming) (Grohmann 2022). Other actions of this type followed throughout the summer, with the same message, although the countdown formula used has been criticized by contributors to the Intergovernmental Panel on Climate Change (IPCC) report as a misinterpretation of the last UN climate report (Toffolet 2022). The name of the group

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initiating these actions is 'Last renovation' (in French, *dernière rénovation*). In a country like France, the residential and tertiary sectors cause one-fifth of greenhouse gas (GHG) emissions. This is enough to turn the renovation of housing into the main focus for a group of activists seeking to fight both the causes and the effects of climate change. For the same reason, it will be the focus on this text, too.

While in temperate climates we often speak of 'fuel poverty' or 'energy poverty' regarding households struggling to heat their homes, the effects of climate change bring with them the threat of what Harriet Thomson and her colleagues call 'cooling poverty' (Thomson et al. 2019). Referring to the inability of individuals to enjoy an environment sufficiently mild to maintain health, this vulnerability is even more obvious in places in the Global South, like in Cairo, which is the case discussed in this paper.

Beyond the fact that buildings in poor condition use more energy to keep people warm and cool, it is relevant to look at buildings when we are interested in climate resilience (Barroca, DiNardo, and Mboumoua, 2013) in cities for at least two reasons. On the one hand, buildings store heat received during the day and release it at night. Urban areas are dense, and thus there are few possibilities for hot air to be blown away, which is what creates the heat island effect. On the other hand, people alter the buildings that house them to cope with the extreme heat. Thus, the built fabric is both an aggravating factor in the urban heat island effect and is what people modify to protect themselves from the heat. This makes climate resilience an architectural issue, articulating both the urban and the building scale, which justifies having a closer look at how people actually deal with the issue of refurbishing their homes to make them thermally comfortable (Ghodbane 2021).

Renovating a house or flat, regardless of the scale of the work, necessarily involves several people with different skills and responsibilities, including counsellors, initiators, retailers, builders etc. Even in materially precarious contexts, such as poor areas in Cairo, buildings are constructed and maintained collectively, and do-it-yourself initiatives are not as popular. One rather calls a handyman to do repairs. Thus, when a homeowner initiates a project, from tiny repairs to, for example, the addition of a floor to the building, they look for support, tools, people, information and financial means in order to develop an

action plan. How do they seek the expertise they need to design, plan and implement their project? How is this organized? What counts in their decisions? Who participates? How do people search for the means to establish and achieve their plan?

This paper is an outcome of a larger research project that I have conducted using the methodological tools of sociology, that is, ethnographic data collection and analysis, participation in events with and for architects in Cairo, interviews and participant observation at a sample of homes in various neighbourhoods to investigate construction and maintenance practices in ordinary residential buildings in Cairo. My aim was to research the intermediaries who take part in an architectural project, in line with the work of Graeme Macrae and Samuel Parker (2002) on the *undagi* in Balinese architecture. These scholars have demonstrated that rather than involving one person embodying architectural knowledge, architectural practice is dynamic and includes individuals with changing skills and status. Therefore, these two authors consider architectural knowledge to be socially located and circulating.

Although I investigated nine homes in different parts of the city, in this contribution I will present only cases of people who worked with architects in the past but who ultimately decided to do without them. Their views provide an idea of residents' priorities and of what architects sometimes fail to deliver. This focus highlights the importance of mediation when it comes to improving housing, which remains a key issue in the fight against climate change. While they demonstrated a great deal of knowledge about housing renovation and climate adaptation, the architects I encountered and read about during my fieldwork[1] shared their frustrations with the obstacles that prevent them from putting their expertise at the service of people. Eventually, the character most often cited when speaking of construction is the entrepreneur,

1. I met with about thirty architects during the field research I conducted in Cairo between 2016 and 2019. I endeavoured to speak to a diversity of practitioners, from those who engage in public activity (museums, publications, television or radio interviews etc.) to those who have no website and do not communicate about their work. All interviewees have been anonymized and their names changed to protect their identities.

or building contractor; in Arabic, *muqawil*. The definition of his role[2] happens to be very versatile, which explains his presence on most residential construction sites, including my case studies. The case of the *muqawil* enables us to define expertise not as the possession of specific knowledge but as the likelihood of someone's knowledge being recognized and applied in its intended context. The *muqawil* provides a way of thinking about the issue of mediation between experts and residents, a central element in implementing climate-change adaptation measures such as thermal renovation.

As the young activist on the tennis court reminds us, the climate emergency requires that we seriously consider how people shape their built environment today in order to enable climate-resilient renovation and construction to actually take place.

BUILDERS AND RENOVATORS WITHOUT ARCHITECTS

MAGDA

Magda and her husband are two engineers in their fifties. They live in a large apartment they own in Garden City, which is a central neighbourhood that used to be affluent. Magda put a lot of effort in thoroughly renovating it, including electricity and plumbing, masonry work (she created an opening in three walls) and, obviously, finishing (floors, ceilings and painting). Choosing the right people for the right tasks was a central issue of the project. As Magda said:

> – I know what I wanted, and I lived (*'isht*) [enough to know what I want now]. … I didn't bring an architect, a real one, who would develop ideas and so on, but one who would do whatever I wanted.
> – Do you mean like a *mu'allim* [master mason]?
> – No, not really, he would be dressed up and everything, he would be a graduate in architecture. I mean, it's not important. I could have taken an architect who would have made a drawing and everything, but it would have been more expensive. I have a friend in *Tagammu'* [*Tagammu' al-Khamis*, literally 'the Fifth Settlement', a satellite town and gated

2. The entrepreneurs were all men, which justifies the use of the pronoun *he*.

> community in Cairo], who is working with an architect like that and who doesn't let her do what she wants [she laughs]. I didn't want that. I wanted to look for the things, to discuss the feasibility, and then he carries out the work. (7 September 2018)

For Magda, architects' distinctive qualities conflict with her wish to implement her own ideas. In this way, her position challenges architects' claimed monopoly on the design that should be implemented in such a project and when improving the thermal qualities of a house. When architects speak about climate in the public sphere – in the press or in books, for example – they focus most often on the technical aspects of climate adaptation in buildings, both low- and high-tech. This includes, for example, the use of thermal insulation, solar panels, natural ventilation and natural building materials such as rammed earth or lime. It also includes the celebration of local traditional architectural features such as the *mashrabiyya* (wooden window lattices), courtyards and air shafts (Vellinga 2013). Mediation between experts and inhabitants is essential to assess both the relevance and adaptation of these techniques in context.

Magda carefully selected the person who would work for her, following criteria that did not directly include the technical competences of her interlocutor but rather a similar social background. By choosing a graduated architect, she ensured that this person potentially shared similar standards of what a 'good house' is. In this case, the social connection between the interlocutors came before (alleged or known) technical competences. This justifies the urgency of examining more closely in which conditions housing renovation techniques are applicable and thus, by extension, how and where climatic adaptation of the built environment can take place.

SAWSAN

Magda's experience resonates with that of Sawsan, who, at first, seemed to have bet on the same implicit 'strategy', as she started working with an architect who was part of her circle of friends for the construction of her villa in the Fifth Settlement. Contrary to Magda's friend, Sawsan was determined enough to actively intervene in the design of her house. She insisted on natural ventilation and natural

light but avoided direct sunlight to prevent overheating. To her, these concerns were absent from the architect's plans:

> He [the architect] brought me a plan, but I [*sound of paper being teared up*], all of this is rubbish. I brought my plans and a corrector. I removed walls, and I put another one, open here, etc. …
> In the architect's plan, the whole staircase was made of glass windows that couldn't be opened. In addition to the heat it is likely to produce, how could I clean all this glass? It was beautiful coloured glass, but it was not practical. (1 October 2018)

What Sawsan says about the design choice of the architect, i.e. the prioritization of aesthetic concerns over climatic constraints by using large glass panels, echoes the assumption that architects' clients are only interested in beauty (*al-gamal*) or looks (*al-manzar*) and are not concerned with the improvement of the thermal qualities of their homes (assuming also that these aspects cannot be combined). Sawsan, however, did not match this expectation, and she insisted on the experience and knowledge gained from previous renovation projects she undertook in her other properties.

The same faithful *muqawil*, Ali, worked for her on these sites and also for the rest of the family. He was actually the *muqawil* of Sawsan's brother-in-law, who is an architect. Her son, who joined us during the interview, insisted on the distinction between *their muqawil* and the kind that one finds in poorer neighbourhoods. Such a distinction, again, was frequently repeated in the conversations I had with my interlocutors during my fieldwork.

The relationship between the owner and those who concretely carry out the owner's project is crucial to the undertaking, which means that it is also important in better adapting housing to future climatic constraints. The experiences of Magda and Sawsan show to what extent the social connection between individuals, or their social distance, plays a significant role in determining the means available to make their project come true.

THE ARCHITECTS

The architects I met advocated the specificity of their profession in various ways. This might not be directly related to the climate adaptation of the built environment, but to actually make thermal renovation come true, we need to understand the existing gap between residents – who actively engage in the improvement of their housing conditions, including thermal comfort – and architects, who have climatic expertise but struggle to implement it when working for their clients.

The image of the architect who obtains their knowledge from abstract theories echoes a comment my host made during my fieldwork. Umm Rania stated: 'Ah, but the *muhandisiin* [architects and engineers], they are into theory; they do not do anything with their hands. They are into computers and calculations' (field notes, 6 April 2018). Later, as I was sitting in the *hara* (here, a dead-end street with a semi-private use) enjoying the sun on a fresh autumn morning, my 21-year-old neighbour Hatem asked me about the research I was conducting. When I talked about architects, his face suddenly lit up, and he said: 'Oh, yes, I see, a guy who makes drawings on a computer and all. I know one in Manshiyet Naser'.

In this particular case, the symmetry between the effort my interlocutors made to distinguish their own function as *muhandis* from the depiction of architects provided by my neighbours showed that the exclusion is somewhat reciprocal: the architect's work does not engage with the people in Cairo's existing buildings, but the people do not acknowledge the relevance of the architect's work to their situation either. In such a situation, how can architectural climate expertise find relevant ground for application and opportunities for improving itself when few people, even educated ones, are aware of the role of an architect?

Architects are caught in contradictions: their opportunities to implement projects largely depend on clients for whom they sometimes show little consideration, and from whom they symbolically and socially dissociate themselves. The image of the architect as supervisor and master of the project contrasts with the actual situation of structural dependency – with their clients, for example – in which architects find themselves.

In sum, there are multiple barriers between residents and architects that prevent the taking of efficient action towards better adapting

Cairo's built environment to future climatic conditions. These obstacles take several forms: they can be material, as hiring an architect is costly and they might impose a high standard of execution, which is expensive as well, but they can also be symbolic. Eventually, people's perception of the architect as an intellectual can inhibit interactions.

THE *MUQAWIL*

The *muqawil* does not seem to experience the same obstacles that architects face in their relationship with people or clients. While the word *muqawil* translates into entrepreneur or contractor, the functions it refers to considerably change according to the situation. As they work with socially diverse households, while they themselves are sometimes part of the working class, *muqawilin*'s (plural) socio-geographical mobility contributes to making them accessible. And unlike architects, the fact that they are devoid of an intellectual aura and theoretical projects likely enables them to address domestic considerations in a concrete manner. Moreover, they are less likely to hamper the owner's decision process in terms of design.

Some consider the *muqawil* to be an investor, i.e. any individual who has capital to invest in a real estate project. This is especially the case in rather well-off neighbourhoods, but not only there. On the other hand, when one speaks of a *muqawil* in a more working-class context, the image and skills of the entrepreneur are quite different, as architect Mahmud Hilmi explains:

> We have a big problem here in Egypt. The awareness of the architect's scope of knowledge is close to zero [nervous laugh]. Those who understand are maybe 5 per cent of the people. But the majority has no idea. If they want to build, they go to the *muqawil* and ask him to build. He wouldn't go to an architect in any case. He would bring somebody to dig up the ground [he gasps] and a *muqawil* with a *libda* [a felt hat], a *muqawil* wearing a *galabiyya* [full-length gown], the picture of the primitive *muqawil*, the very simple *muqawil*, and he would do the building. There's no concern about who'll do the *design* [my emphasis]. They want the building to be as high as possible and as large as possible. I'm talking about a certain sector of course, the simple people. In the villa, it would be a bit better. (24 April 2019)

The *muqawil* as described in this extract ticks all the boxes of being the opposite of the architect. He builds without any design consideration and without any purpose other than that of maximizing financial profit. This contrast is not only embodied by the *muqawil* himself but also by his so-called traditional clothes and the social background of those he supposedly serves, namely the 'simple people'. In a nutshell, depending on the social environment in which he intervenes, the *muqawil* is a business manager, a site supervisor or a *mu'allim*. It is this broad spectrum of potential roles that makes him accessible and enables the *muqawil* and his skills to circulate. This indeterminacy of the *muqawil*'s scope somehow echoes the versatility of the architect's functions (Chadoin 2013), which makes him appear as the architect's alter ego. The qualities that make him omnipresent are assets that those embodying building expertise on the urban climate lack, preventing them from implementing a climate-resilient city through housing improvement.

FROM THE BUILDING TO THE CITY'S CLIMATE

The ability to create 'a micro-climate on one's own' at home depends on the resources available. The importance of individuals' social networks in the quest for intellectual, material and practical resources when planning projects to improve domestic spaces illustrates well the fact that

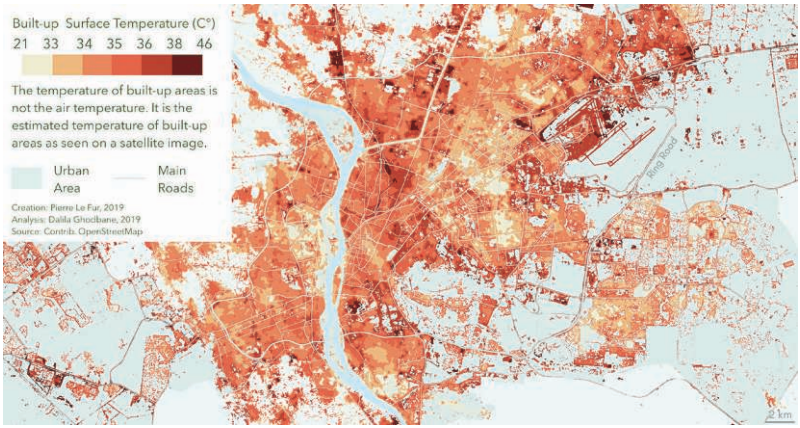

Figure 1. The densest built-up areas overlap with those with the highest land surface temperature (1 August 2018). Source: Ghodbane (2019a).

architectural agency is distributed between several hands and brains rather than embodied in the architect's character. Social connections rely on tacitly shared conceptions about what a good house is; in other words, it relies on actors' silent agreement on what is desirable. In this sense, the thermal environment is an intentional collective construction that follows existing social patterns. This acknowledges people's agency in shaping and controlling their thermal environment following specific logics and contexts. Even if heat rules the life of Cairo's people, it affects them differently depending on whether they live in a wealthy district or a more working-class area (Ghodbane 2019b; Roesler, Kobi, and Stieger 2022). Microclimates differ according to the location and urban fabric of a neighbourhood, and possibilities to mitigate overheating are not the same. This is visible in Figure 1, a map showing the built-up surface temperature in Cairo.

If we compare this image with an aerial view of Cairo, we see that the pockets in the satellite image where the heat is greatest correspond roughly to the most densely built-up areas. The very dense areas are home mainly to a relatively low-income population. In contrast, the areas in lighter colours tend to be upper-middle-class. There, the buildings are lower and the streets wider. Trees and parks create breathing spaces in the urban fabric, which help moderate the micro-climate. Knowing that people experience the heat differently according to the environment they live in has material consequences for their homes and their ability to shape them in relation to the surrounding urban micro-climates. For example, if the outdoor environment is a calm, tiny garden that is cool in the evening instead of a busy, dusty street, windows will not be used in the same way, which impacts the indoor thermal environment. Considering climate realities at the neighbourhood or building and housing scale makes it possible to understand environmental inequalities in context, through the prism of adjustment and accommodation practices in people's domestic sphere.

CONCLUSION

In this article, I have focused on individual initiatives because this is where the balance of power between those who take part in the maintenance of the built environment is potentially favourable to the dissemination of architectural knowledge and climate-responsive

design on a large scale. I have done so by shifting our gaze from architects to architectural practice and to how this is embodied beyond architects' profession and understood among city dwellers and most non-expert residents eager to refurbish their homes according to climate demands. The same can be said about expertise in urban climate management. In other words, in the case of renovation projects implemented without the help of an architect, architectural practice is not absent; rather, it is shared by multiple hands, which enlarges the pool of resources available to make projects happen.

People's easy access to *muqawilin* (entrepreneurs or building contractors) exemplifies what architects bemoan, that is, opportunities to exert their skills to improve homes, including in terms of climate-responsive design. In this sense, expertise is in the eye of the beholder. Regardless of the construction quality or the design of what ends up being built, this shows interesting channels to explore in view to implement constructive solutions to overheating. A lot of existing knowledge (related to climate or to architecture) struggles to prove its relevance on the ground to the people it is dedicated to. This lies at the origin of frustrations that architects express in interviews and sometimes in their publications. Therefore, mediation is also a central issue when thinking in terms of action. It sheds light on the logics and drivers of renovation that exist among residents and homeowners when they plan their projects. Looking closely at how people renovate their house equates to mapping expertise as it is identified by those who produce the city instead of locating it in the hands of the experts alone. Mitigating the effects of climate change simply cannot be achieved without addressing the actually existing forces that produce the city at all scales, especially the already established Cairo as opposed to the new settlements.

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ROMANI BADIR AND BÉNÉDICTE FLORIN*

USEFUL!
FOR A RECOGNITION OF WASTE PICKERS IN THE CIRCULAR ECONOMY

AN INDISPENSABLE BUT UNRECOGNIZED COMMUNITY

Called the 'Zabbaleen' in Egypt, the waste pickers of Cairo are located in 'garbage zones' that occupy some of the deepest and least accessible recesses of the city's extensive outer fringes, although some neighbourhoods are now integrated into the city due to urban sprawl.[1] Despite the Zabbaleen's enormous historical – and discreet –contribution to the everyday functioning of the city since the 1930s, they are frequently threatened with eviction because of their practice of raising pigs and because they live surrounded by piles of waste. The Zabbaleen have been neglected by authorities despite providing a

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Bénédicte Florin is Assistant Professor of geography at the University of Tours and a researcher at EMAM (Equipe Monde Arabe et Méditerranée) of the research centre CITERES (Cités, Territoires, Environnement et Société). Her research focuses on cities in the Arab and Turkish world. Since 2007, she has been particularly interested in the issue of waste pickers and waste-management policies and systems in Cairo, Casablanca, Istanbul and Paris.

1. This article is the result of a presentation by Romani Badir at the Cairo conference on climate change in March 2022 and the many discussions he has had with Bénédicte Florin since 2007. It also includes excerpts from Florin's article 'The Ragpickers of Cairo: The Dregs of the City or Garbage Businessmen?' (2015).

crucial but unpaid public service. This community was invisible for a long time in geographical, social and professional terms; paradoxically, they were better known abroad, by associations and charities, than in their own country. And, paradoxically again, they were brought to light from the 2000s by public policies that were carried out without consulting them. The other event that suddenly brought them to the fore was the slaughter of their pigs in 2009.[2]

Following a complex system of territories, they collect household waste door-to-door on each floor of thousands of buildings, providing an otherwise almost non-existent service. As Romani Badir explains: 'Regarding the collection of waste in Greater Cairo – exclusively, without mentioning the rest of urban Egypt – we receive around eleven thousand tons of waste on a daily basis! Needless to say, how big that number is!' The Zabbaleen's recycling workshops require a steady supply of raw household waste, which is also used to feed their pigs. Their fine-grained knowledge of when and where they can circulate and the optimal times and places for high-quality waste often leads them to venture quite far outside their neighbourhood.

THE RISE OF MANSHIYET NASSER: A QUASI-INDUSTRY OF RECYCLING

The overall volume of waste that is sorted and recycled by the Zabbaleen – primarily in the privacy of their neighbourhood – grew significantly in the 1980s and 1990s, particularly in one of Cairo's largest recycling districts, which is home to 60,000 of the capital's 100,000 waste pickers. This district is located in Manshiyet Nasser. There, workshops, tools and machines, often built by the workers (testifying to their ingenuity), are gradually multiplying. Today, there are estimated to be more than a thousand recycling workshops with machines, mainly for plastics but also cardboard (which requires a lot of space), while a few recycle aluminium. Badir explains:

2. In May 2009, under pressure from the Muslim Brotherhood, the Egyptian government brutally butchered 300,000 of the waste pickers' pigs. The AH1N1 flu outbreak, which was falsely labeled the 'swine flu', triggered this scientifically unjustified and egregiously unfair decision.

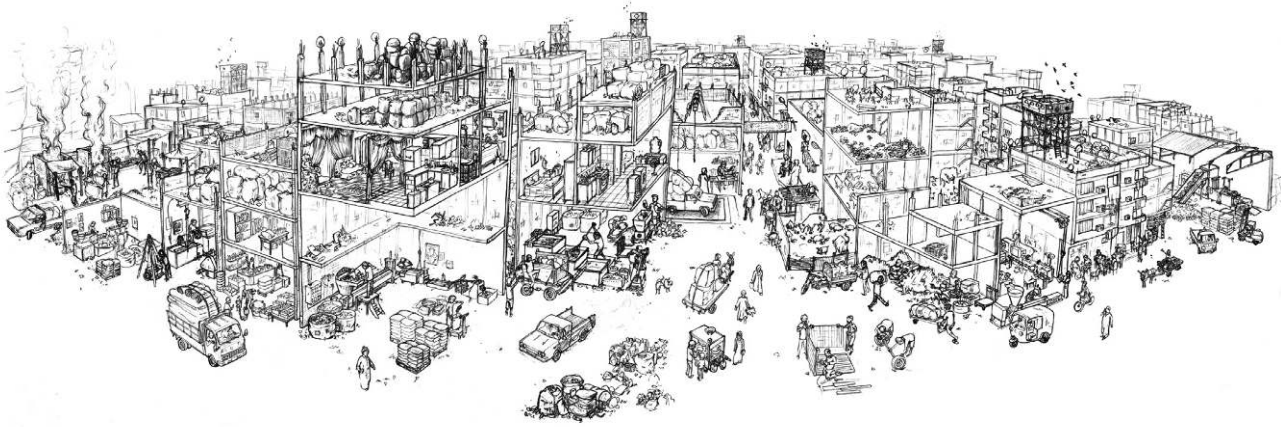

Figure 1. Section of the Zabbaleen district Manshiyet Nasser. Source: Batchou, 2017. Graphite and china ink on paper, Rothau, France.

> The main point is the idea of the presence of small projects, or enterprises in a way, that operate by collecting this waste from a place where the workers collect, sort the waste into solid waste, organic waste, etc. All being separated, each item then goes to the Zabbaleen's recycling workshops to be recycled and repurposed. … The development that we as Zabbaleen aim for is working and working some more, even if it means copying foreign recycling machines; mainly because of their original expensive price, which we reduce by copying them.

THE ROLE OF PIGS AND MOVEMENTS OF MATERIALS IN THE CIRCULAR ECONOMY

Before 2009, a Zabbaleen family's wealth was based on the number of pigs it possessed. Because pigs consumed 40 per cent of the organic contents scavenged from garbage bins, they were a crucial link in the waste chain. Pig excrement fetched a high price as fertilizer, as did their meat, which was sold to Cairo's four pork butchers. Indeed, far from being an isolated activity, the recovery of materials is integrated into specific networks and is deployed at different scales. These networks, which tend to take years to develop, are indicative of the highly refined negotiating skills of a community often treated as pariahs. Some Zabbaleen have even developed retail outlets to re-sell cardboard boxes and plastic drums, while others have negotiated to collect prized organic waste from the city's large hotels, as Badir explains:

> Normally, we don't sell organic material because when it comes from homes the quality is poor, but when it comes from a large hotel, we sell it to neighbours who need it to quickly fatten up their pigs. Before we butcher the pigs, we are even prepared to pay the hotels! … Now, as I often tell people, they can eat their garbage themselves!

Sales networks for pre-sorted or recycled materials have also proliferated and diversified. Wholesalers purchase manufactured goods from Manshiyet Nasser, while compacted boxes and cans are sold to factories in the official sector and plastic balls and palette-loads of compressed plastic bottles were distributed to a Chinese-owned factory and shipped to China (this destination was replaced by an Egyptian

company in 2021). Distribution agreements between workshop bosses in Manshiyet Nasser and Zabbaleen located in provincial cities or tourist sites have also increased, reflecting the community's ability to maximize the yield of the capital's voluminous waste stream.

THE PROFESSIONALIZATION OF THE ZABBALEEN

Sophisticated recycling techniques involving a range of materials, expertise in negotiation and sales and collaboration with other industrial networks illustrate the rapid professionalization of the trade. Individuals who scavenged for scraps of food for their animals as children have been transformed into influential bosses in a decentralized system that has organically but steadily expanded. While a high degree of professionalization is not necessarily universal among the waste pickers, it has had a number of side effects that include initiatives to educate children and improved housing in new apartment buildings, particularly since the revolution and rising demands for labour rights. These positive developments have all been strictly dependent on continued access to household waste.

Similarly, entrepreneurial initiatives have multiplied, increasing recycling efficiency, as Badir explains:

> If you want something to become a success, it has to be useful. Taking the operation of waste recycling for instance, we recycle 90 per cent, and the other 10 per cent, we don't. These 10 per cent aren't left aside because of our incapacity to recycle them but mainly because they aren't of much use. In other words, their raw material is far cheaper than the wage of the worker who's going to handle it: for example, recycling fifty kilos of waste with the wage of two workers while those two get their wage usually for recycling 300 kilos of waste – it's unfair! In addition to that, it's extremely difficult to deliver 500 tons [those 10 per cent] to dumpsters that have the capacity of only a 100 [tons], as this would lead to the existence of dumpsters [in an unorganized manner] everywhere in Egypt.

The Zabbaleen of Manshiyet Nasser lost the right to burn non-recyclable residue over ten years ago. However, waste is still responsible for a very large part of Greater Cairo's CO_2 emissions, in particular because of deposits of waste burned in unserved neighbourhoods.

These questions of pollution linked to waste – in particular toxic waste – are the subject of increasing awareness. But the lack of pre-sorted collection makes it difficult to find solutions today, according to Badir:

> To cite an example, especially that of batteries that contain toxic substances, each of us should first place them in a sealed plastic bag, because they must be recycled separately. They contain heavy substances (cadmium and lead), which can leak and contaminate other waste such as organic waste, which would cause huge problems. This organic waste – then poisoned – is often reused as animal feed and the manure is also used as organic fertilizer for agricultural land. Therefore, toxic products come back to us and also poison us through food. This paves the way for kidney failure, liver failure and many other dangerous diseases.

RECYCLING AS A PROFESSION AND ITS IMPACT

Finally, it is worth mentioning that the organization of the work is changing at the scale of workshops and of the district of Manshiyet Nasser, as Badir states:

> Certainly, since each Zabbal works in person in his own workshop, he cannot be regarded as an employee but is rather an owner. The difference to be highlighted is that in case of an employee, he's only bound to work certain days, even if up to thirty days a month, for set hours and then gets his salary. While in the case of an owner, he has a bigger interest [than salary], that is profit. For him to achieve that, he must look for two main factors: the quality and quantity of work [waste] to be done. Giving the example of recycling various types of plastic, such as polypropylene, polyester, etc., for them to be developed [into profit], I need to search for quality. This quality is never achieved by getting them out of the trash without cleaning, sorting, etc. So, missing the quality, it shall be sold very cheaply, which won't achieve the desired target: profit. A ton of waste guarantees job offers for six families – a worker of each: where a collector, a categorizer, a handyman, another for compressing cardboards, etc. are needed.

Cairo's Zabbaleen have often been 'studied' and held up as an example of exceptional recyclers, even though dire working conditions

(particularly for women who sort or children at work), health issues and their non-recognition in terms of social rights and labour rights have still not been resolved. Their know-how and ingenuity in recycling remains essential because, as Badir says, the 'end of plastic' will not come tomorrow:

> Repeatedly and often have I heard that many are expressing the necessity of giving up plastic [use]. Honestly, from what I know, plastic is considered one of the miracles that happened to us within the last two hundred years. As such, I cannot give up plastic, but I can very much reduce its usage. Plastic that is used to cover copper wires to avoid electrical shocks, the same for electrical pipes. Also used in cars' tyres, we obviously need its presence. So, the issue to address should be how to reduce its usage by finding alternatives for it where it's mostly used, but never to give it up.

The question that arises is how best to support the work of this community after the successive obstacles encountered: the modernizing reforms of the 2000s excluding them, the slaughter of their pigs in 2009, the demolition of some of their neighbourhoods, such as Batn el-Baqara, etc. Although they seem to receive a little more respect than fifty years ago, the Zabbaleen's position has not changed. Meanwhile, huge competition around waste will increase in the future. We have seen this in Turkey, where 'informal' wholesalers are driven out of Istanbul, replaced by official companies or 'friends' of the municipality (Florin 2016).

Let Badir have the final word:

> Recycling works; we take it as a job where we are inventive and creative. Thus the collection of approximately 1,000 tons of paper and cardboard makes it possible to deliver to the factories. As you know, their raw material is trees. Collecting these materials from the waste automatically means that we have protected/saved over a thousand tons of trees from being cut down. These trees are known for their operation of photosynthesis using carbon dioxide to provide us with oxygen. So, through our recycling work, we protect the lungs of the earth [the trees] and by default the oxygen we breathe.

> We – the Zabbaleen – are so proud that we're doing something [about climate change] and taking up a challenge. A tough job, but we're most certainly capable of doing it and we're welcoming any of those who want to see [our work]. The situation raises the question of 'What can I do?' to protect durable cities? Start with yourself [I would say]. There isn't such thing as someone who doesn't work, even students, many have their work day starting at 3 or 4 a.m., etc. Our area, for instance, is taking up to 15,000 workers, mostly from Upper Egypt of course. We're still creating job offers, guaranteeing the presence of foreign currency and we recycle. With recycling, I urge every person to start with him- or herself, to be a leading example when it comes to the protection of the environment, whether when it comes to their work or anything/anywhere else.

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PART II

PATHS FOR DE-CARBONIZATION AND BIODIVERSITY RECOVERY

LEÓN DÍAZ-BONE*

SUSTAINABLE URBANIZATION AS A KEY TO ADVANCING INTERNATIONAL CLIMATE AGREEMENTS

INTRODUCTION

Cities have always played a role in the United Nations Framework Convention on Climate Change's (UNFCCC) process and meetings.[1] A key actor in facilitating their input and engagement is ICLEI – Local Governments for Sustainability, a city network that acts as the official focal point of the Local Governments and Municipal Authorities (LGMA) observer group to the UNFCCC. This text will shed light on the history of this engagement and will outline the prospects for the topic of sustainable urban development at the UNFCCC COP27 in Sharm El Sheikh in November 2022.

ABOUT ICLEI

ICLEI – Local Governments for Sustainability is a global network of more than 2,500 cities and subnational governments in 125 countries committed to sustainable urban development. The non-profit

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1. This article is part of the conclusion to the March 2022 conference.

Figure 1. ICLEI's five strategic pathways for sustainable urban development. Source: ICLEI (n.d.).

organization has more than 300 in-house experts in sustainable urban development across twenty-four offices around the globe. The ICLEI World Secretariat has been hosted by the city of Bonn in Germany since 2009 and currently employs staff from over thirty different nationalities.

ICLEI conceptualizes sustainable urban development across five interlinked pathways (ICLEI – Local Governments for Sustainability n.d.; see Figure 1).

Currently, the organization is involved in more than two hundred active projects, which typically integrate actions across multiple pathways.

ICLEI AND ITS ROLE IN THE UN SYSTEM

ICLEI was founded at the margins of the UN General Assembly in 1990 and tasked with preparing the input of cities to the 1992 Earth Summit in Rio de Janeiro, Brazil. From this summit, three UN conventions, the so-called 'Rio conventions', emerged: the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention on Biological Diversity (UNCBD) and the United Nations Convention to Combat Desertification (UNCCD).

Out of these three, the most well known is the climate (UNFCCC) Conference of the Parties (COP), which will hold its twenty-seventh meeting in Sharm El Sheikh, Egypt, later this year. In these conventions, as is usual for the UN as an intergovernmental body, negotiations occur between the parties to the different conventions, which are all national governments. However, the three conventions all foresee mechanisms for the engagement of civil-society stakeholders as observers, who have a right to intervene in the discussions but no right to vote on or veto any outcomes and decisions. Observers are classified into different *observer groups* (e.g. Indigenous people,

businesses, research organizations etc.), whose exact naming varies between the conventions. Nevertheless, all three Rio conventions count on an observer group to facilitate the engagement of cities and subnational authorities. ICLEI acts as the subnational government focal point for the three Rio conventions and is tasked with coordinating the input of the various stakeholders in this group (cities, subnational authorities and their networks) into the negotiations.

THE ROLE AND RECOGNITION OF CITIES IN THE UNFCCC COP PROCESS

The earliest outcome of the UNFCCC process is the 1997 Kyoto Protocol (agreed upon at COP3), which makes no direct reference to cities. This changed only with the 2015 Paris Agreement (outcome of COP21), 'recognizing the importance of engagement of all levels of government' (Paris Agreement, Preamble para. 15, see United Nations 2015; Arikan 2021, slide 4). The same agreement paved the way for the establishment of the Marrakech Partnership for Global Climate Action, recognizing the important contribution of non-party stakeholders, including cities. This created the function of 'High-Level Champions', which act as figureheads to mobilize non-party stakeholder engagement, including from cities, through initiatives such as the 'Cities Race to Zero' and the 'Cities Race to Resilience', which offer the opportunity to mobilize and collect commitments from cities on their own mitigation and adaptation efforts (UNFCCC 2016; UNFCCC Climate Champions 2022).

At COP26, the reference to subnational action was strengthened through the 2021 Glasgow Climate Pact (outcome of COP26), 'highlighting the urgent need for multilevel and cooperative action' (Glasgow Climate Pact, Preamble para. 9, see United Nations 2021) as well as including multiple other references to local and regional governments (Arikan 2021, slide 4).

Since UNFCCC COP1, ICLEI has actively mobilized mayors and other subnational leaders to attend the UNFCCC COPs and represent their collective interests on the official stage. In Glasgow, at COP26, the number of subnational leaders attending events in the Blue Zone surpassed four hundred, unofficially accounting for the third-largest of all delegations.

While the contributions of subnational government levels are increasingly recognized in convention texts, the logic of the agreements remains unchanged: the Paris Agreement foresees that each party submit a nationally determined contribution (NDC) to collectively achieve a sufficient decrease in carbon emissions. In Glasgow, the originally intended five-year cycle of submissions was shortened to allow for the resubmission of improved NDCs towards COP27 in Sharm El Sheikh. Under these conditions, how can cities come into the picture at the COP stage?

For many years, ICLEI has been promoting and supporting governments to engage in multilevel collaboration and action to inform the NDCs. This follows the logic that coordinated efforts across different levels of government can prevent silos and circumvent responsibility and resource gaps, thus increasing the efficiency of joint efforts. In the lead-up to COP26, sixty parties submitted an NDC that included a multilevel action component (Arikan 2021). Half of these parties pertain to the Global South, proving that the concept is applicable across different geographic contexts and levels of development. Through funding from the NDC Partnership, ICLEI was able to assist seven national governments in Africa and Latin America in the redesign of their NDCs before COP26 and looks forward to continuing to assist national governments around the world in similar efforts in the future (NDC Partnership 2021).

Figure 2. UNFCCC COP parties that have submitted a multilevel NDC. Source: Arikan (2021).

OUTLOOK TOWARDS UNFCCC COP27

At the *Facing Climate Change: Making Sustainable Cities Conference* in Cairo in March 2022, the Egyptian Minister for the Environment, Dr Yasmine Fouad, stated that 'Sustainable cities will have a place at the heart of COP27'. Speakers and participants alike agreed that, with 55 per cent of the global population living in urban areas and cities being responsible for an estimated 60 per cent of global material processing or consumption and 70 per cent of greenhouse gas (GHG) emissions, the topic of sustainable urban development in Egypt and abroad remains a key area of action to achieve the objectives of international sustainability agreements such as the Paris Agreement (UN-Habitat 2020).

Since then, the Egyptian COP27 Presidency has significantly advanced on two developments that will raise the visibility and recognition of sustainable cities in the COP arena:

- Supported by UN-Habitat and ICLEI, the Egyptian COP27 Presidency, under the leadership of the Ministry of Foreign Affairs and involving responsible line ministries, has initiated an initiative on sustainable cities under the name of 'Sustainable Urban Resilience for the next Generation' (SURGe, see UN-Habitat and ICLEI 2022). This initiative was developed in a collaborative process with a multistakeholder group of national and local governments, a wide range of urban actors, multilateral development banks and other UN entities. It aims to build on and add momentum to existing initiatives, and provides a holistic framework to achieve sustainable and resilient urban systems (UN-Habitat and ICLEI 2022). As it is sponsored by the COP27 Presidency as the highest political body of a UNFCCC COP, this constitutes an elevation of the topic of sustainable urban development to an unprecedented level of importance.
- At the UN-Habitat Executive Board meeting in March 2022, Member States requested that UN-Habitat's executive director explore with the COP27 Presidency the possibility of convening a housing and urban development ministerial meeting on cities and climate change to be held at COP27. Under the leadership of the COP27 Presidency and hosted by the Egyptian Ministry of Housing, this first-of-its-kind Ministerial Meeting on Urbanization and Climate Change will be convened at the COP27 Solutions

Day on 17 November 2022 in Sharm El Sheikh. This ministerial meeting aspires to being the foundation to create a long-term legacy and representation of urban issues in climate negotiations. Its ambition is that, combined with the SURGe Initiative, it will help involve key urban actors more strongly in the implementation of the Paris Agreement.

While urban actors have always had a role to play as observers in the UNFCCC COP process, they were off to a somewhat bumpy start in terms of recognition. Since the 2015 Paris Agreement, there has been a growing recognition of the important contributions that sustainable urbanization can make to reaching international climate goals. COP27 might further add to this through the SURGe Initiative and the envisaged first-of-its-kind Ministerial Meeting on Urbanization and Climate Change.

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NABEEL EL HADY*

ADDRESSING WASTE AS A BASIS FOR REGENERATIVE TRANSFORMATIONS

INTRODUCTION

Garbage accumulating on the streets in Egypt's urban and rural areas creates serious problems in terms of hygiene and creates a sense of chaos. One often hears complaints from locals as well as visitors, and these lead to recurrent attempts by the government to address the garbage problem. This is not a new phenomenon (Fahmy 2022). In his book *In Quest of Justice*, Khaled Fahmy writes about the time of Muhammed Ali, when garbage full of organic waste was associated with bad air and odours. This led authorities to issue orders to continuously remove waste dumps from within the city, in particular from areas close to the Khalig el-Masri Canal. The idea that air quality is impacted by garbage odours and is therefore an important aspect of what is considered a good urban location was pinpointed by other authors (Raymond 1994). Raymond writes about the site selection of the then new city of Cairo. The Fatimid commander sought the help of his advisers, who hung fresh pieces of meat in different locations. The place where the meat stayed fresh the longest was seen as having the best air and as better fit for human life.

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Successive governments were keen to address the city's solid waste, as is clear from their formal announcements. Increasing negative feedback, particularly from tourists, has led to a recent rise of interest in tackling the issue. In 2020, the House of Parliament issued Law no. 202, which is concerned with solid waste management. According to the law, waste is defined as materials or objects abandoned by their owners in a state in which they either can be recycled or need to be discarded. This waste can be divided into municipal waste, demolition waste, industrial waste, agricultural waste, non-dangerous items and dangerous items. Law 202 introduced new, interesting concepts, such as the extended responsibility of the producer; it also emphasized the integrated management of solid waste and the importance of having a national strategy for this. Whether this strategy will be based on a clear vision to deal with waste remains to be seen.

After the issuing of Law 202, the Ministry of Planning published a report on the state of the sustainable development goals (SDGs) in Egypt at the end of 2021. Goal 11 was among the highlighted goals: 'making cities and human settlements inclusive, safe, resilient and sustainable' (United Nations n.d.). The sixth goal aims at 'minimizing the negative environmental impact of the individual in cities, including special attention to air quality and municipal waste management by 2030' (United Nations n.d.). One of the metrics used is the percentage of solid waste collected and recycled in cities compared with the amount of waste generated.

Solid waste in Egypt is estimated to be 28 million tons a year, and only 62 per cent of it is collected and transported (Ministry of Environment 2019). The ambition is now to increase the proportion of solid waste that is collected and transported to 88 per cent by 2022, which if achieved will be a manifestation of a significant advance in solid waste management. While another estimate (GIZ n.d.) uses different figures to gauge the existing situation and predict yearly increases, it also points to an important fact regarding the organic part of this solid waste, which is estimated to be around 50 per cent on average. Indeed, a recent study (Kamal 2020) showed that organic matter formed more than 60 per cent of solid waste in a rural area south of Giza.

Accumulated observations from different field studies in Egypt show the clear connection between water use in agriculture for food production and the amount of virtual water that is wasted through organic waste, which is definitely linked to water being wasted directly through drainage.

UNDERSTANDING WASTE PRODUCTION

To better understand waste, we need to begin with the two main factors that determine the amount and nature of waste produced in a society: population numbers and their consumption patterns.

Whether solid or liquid, the amount of waste produced depends on the population and the ways in which it consumes goods. The global population has increased significantly (including in Egypt) since the industrial revolution. The creation of factories in cities required thousands of workers to operate on a daily basis. These new factory workers migrated from nearby rural areas due to the promise of better wages and relatively better living conditions. Yet, particularly in the early decades of the mid-nineteenth century, unprecedented crowdedness ensued. This led to the rapid deterioration of living conditions in cities, which was manifested in the accumulation of garbage along the streets. The deterioration of public health and the spread of cholera necessitated a response. In 1842, a report by Edwin Chadweck discussed the unhealthy environment in which workers and the common population lived. London became 'the city of dreadful night' (Chadweck 1842).

The first response was to establish municipalities with powers to collect and transport garbage. Yet, after John Snow pointed to the connection between polluted drains and water wells, which was confirmed by Louis Pasteur (who identified the germs responsible for contamination), the separation of waste water from fresh water was introduced. City sanitation networks began to be built in Paris.

In Cairo, Mohamed Ali started to address the cause of bad smells in the areas around the Khalig el-Masri Canal and other seasonal water bodies. He started with filling El Azbakeya Lake and transforming it into a garden during the fourth decade of the nineteenth century. Major transformation happened after the return of Ali Mubarak from his studies in France (Fahmy 2022). During his stay in Paris, he was

impressed by the sewage network built under the streets that kept the city's air fresh and healthy. After he was appointed Minister of Public Works, he focused on the areas thought to cause forms of sickness. He wanted to drain Khalig el-Masri that, during the month after the annual flood, had turned into a stagnant water body and turn the canal into a wide street, which is now known as Port Said street.

WASTE AND CONSUMPTION

The twelfth SDG addresses sustainable production and consumption. It identifies specific targets for reducing waste, particularly food waste, by half by 2030. It also emphasizes the importance of turning to more responsible and sustainable ways of consumption and production. In the West, the prevalence of the industrial mode of production and the endorsement of capitalism created the significant challenge of over-consumption (Bocock 1993). And, as noted by Monbiot (2020), the average annual increase in consumption rate for the former is around 3 per cent, while the average increase worldwide is 1 per cent.

Consumption growth and accumulation led to most economies feeding on limited and non-renewable natural resources. After everything is consumed, what remains is dumped. This consumption mode is known as a linear economy.

WASTE AS A THREAT TO LIFE SYSTEMS ON EARTH

The significant increase in the consumption of non-renewable resources after World War 2 led to a response from the scientific community, starting with Rachel Carson's *Silent Spring*. With the support of the Club of Rome, four MIT scientists authored the historic report *The Limits to Growth* (Meadows et al. 1972), in which newly emerging computer capabilities were used to model the impact of intensive human activities. The report concluded that humanity was on a very dangerous path, on which the current mode of consumption could lead to a collapse of natural resources and of the human population.

The alarm sounded by this report required a serious response. One of the first responses was the formation of the United Nations' World Commission on Environment and Development in 1983, headed by Gro Harlem Brundtland. Its main contribution was to define 'sustainability' in the report *Our Common Future* (World Commission

on Environment and Development 1987). This report inspired what came to be known as the 'millennium goals'. In 2015, the more elaborate SDGs emerged, which outlined detailed targets and measures in order for humanity to live in a way that would not deny future generations their rights to enjoy the earth's natural resources. Yet, the seventeen SDGs were implicitly presented as being of equal importance to one another.

Rockström and Sukhdev (n.d.) saw this seemingly equal representation of sustainable goals as misleading and came up with what they called a wedding cake diagram. In this diagram, the base is composed of four goals: water, climate action, life under water and life on land. These four goals represent the state of the earth's biosphere, on which come goals related to the social aspect of sustainability. The third layer concerns the economic aspect. This diagram emphasizes the vital role of the four goals of the biosphere, without which there is no way to fully address other goals. This important diagram is based on earlier work by Rockström and Sukhdev (2009), in which they identified nine critical planetary boundaries that are crucial for the support of life on earth and without which no one can talk seriously about sustainability.

Among the many consequences of the wedding cake concept is that one cannot start addressing SDG 11, which deals with sustainable cities, without first addressing the four biosphere goals at the base of the wedding cake. It is not feasible to address solid waste without dealing first with water, climate change and biodiversity. Here, you also cannot separate biodiversity from climate change and the water system.

Soil microbiologist Walter Jehne argues that we need to stop focusing on emissions when talking about climate change. The emphasis on greenhouse gases (GHGs) alone distorts the reality of climate change, which he understands differently (Investing in Regenerative Agriculture and Food 2021). His lifelong work focused on the energy flow in nature and on how plants play a major role in regulating the earth's temperature. As he points out, almost 95 per cent of the energy flow in nature is regulated by the biosphere, where different types of plants enable energy to flow smoothly. The planted soil absorbs solar energy and transports it through water into plants, where transpiration enables excessive heat to be released as water vapour. All this

happens while plants absorb carbon dioxide that is transformed into their food. Eventually the water vapour condenses at higher altitudes into clouds and moves so that rain falls on other lands.

One of the conclusions of Jehne's work is that for each per cent increase in organic carbon in the soil, an additional 250,000 litres of water can be stored on each hectare of land. This stored water is crucial for fighting drought and increasing resilience to floods. He concludes that restoring the natural system and in particular the water system is our shortest way to regulate heat on earth and combat climate change.

CAN MIT RAHINA TEACH US SOMETHING ABOUT WASTE (AND BIODIVERSITY)?

Following Jehne, I argue that restoring the flow of water is essential to combat climate change. I am interested in exploring the extent to which this argument is relevant to better understanding and addressing waste management in Egypt. My work over the years in several local contexts, in particular Mit Rahina, might help us investigate this relation.

Figure 1. The Nile river floodplain where Mit Rahina is located. Source: Hager Mohsen, on a Natgeo map maker.

Figure 2. The condition of the drain in Mit Rahina. Source: Photos by Nabeel El Hady, 2020.

From Fall 2018 and until Spring 2021, a team of students and I studied the challenges facing Mit Rahina as well as possible responses to them.[1] According to what we had learned previously from Burg Rasheed and El Qusier, we prioritized water systems among the other systems we studied (Cherif 2020; Ragab et al. 2020). The study of water systems included agricultural irrigation and drainage systems, domestic freshwater supply and black water discharge. The photograph in Figure 2 shows part of this water system, where solid waste and liquid waste are being dumped and discharged into the agricultural drain at the centre of the village.

Our study of the village environment helped us understand it as an open system, where inputs such as domestic water are pumped through the local grid and enter the local system. The local system was understood to have ecological boundaries, such as the riverbank and

1. During Fall 2018, Spring 2019, Fall 2020 and Spring 2021, around thirty-five students from different countries attended a class organized at Cairo University's department of architecture and submitted group term papers that featured thorough analysis and ideas to address the challenges facing Mit Rahina.

the edge of the western desert. Other materials are getting out of the system, including waste water (Figure 3).

We furthermore tried to identify the micro- and the meso-scales that impact the conditions of the local system. The Nile river basin was identified as a macro-scale component, out of reach of our student team.

One immediate consequence of this understanding of the water system is the necessity of juxtaposing the challenges of Mit Rahina and those of the Greater Cairo Region (GCR) and the Nile River Valley. Any future thinking about the GCR needs to facilitate the natural flow of water, which is essential for any sustainable and regenerative thinking about the villages in the area and the city as well.

Even this initial understanding of the village as a complex system that needs to be grasped on multiple levels has important implications for the long-neglected yet crucial relation between city and villages. Interlinkages between the different sizes of urban settlements on the river floodplain are crucial for fully understanding the complex urban situation in Egypt and addressing its impact on the natural environment.

In our study of the local water system in Mit Rahina, challenges were apparent, including the absence of a public drainage system. This results in people depending on septic tank systems that need to be emptied by truck every two to three weeks. In addition to being costly, this practice also leads to constant leaks into groundwater and the soil. This solution is also detrimental to local fields and the soil, since the local population often has no other solution than to empty its septic loads in a main agricultural drain nearby. This causes even more pollution to the water system, because many farmers use water from the drain to water the crops.

Another challenge is the unstable water supply in terms of quantity and duration: four informal water treatment stations – using filters without proper health control – provide water to local people. Students estimated that roughly 20 per cent of local freshwater needs are fulfilled by these informal water stations (Cherif 2020). As the main source of these stations is groundwater, and given the leakage from septic tanks, the potential of water contamination is a real hazard. The contaminated agricultural drain water that is used to irrigate crops, even as a secondary resource, also undermines the safety of these cultivated areas.

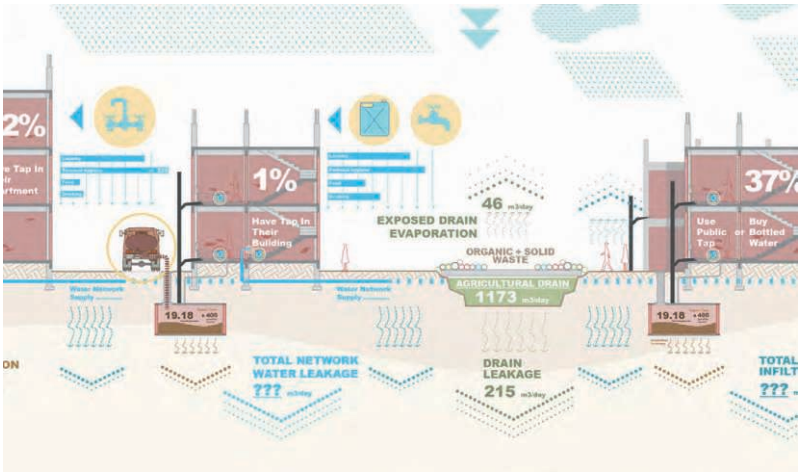

Figure 3. Domestic waste water in Mit Rahina and its relation to agricultural drainage. Source: Ragab et al. 2020.

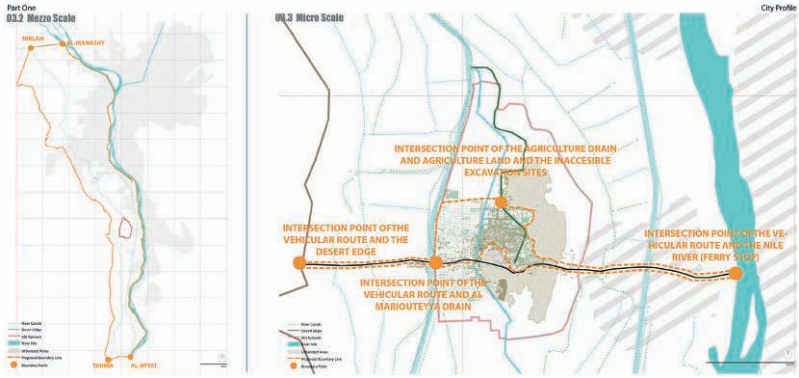

Figure 4. Micro- and meso-maps of water system in Mit Rahina. Source: Ragab et al. 2020.

The results of our study of the water system in Mit Rahina have been drawn as a Sankey diagram in Figure 5.

The findings of our study impressed us because of the large amount of water used to grow agricultural crops and used in other products, such as clothes. Virtual water is a term coined by Allan (1998), which points the amount of water used in the production of certain item, is estimated to be almost eight times as high as domestic water use in Egypt (Wahba, Scott, and Steinberger 2017). Even with the understandable variation between rural and urban areas, this huge difference enables us to better understand the local water system. The interesting point here is that as considerable parts of agricultural and other products end up as waste, a considerable volume of water is being wasted. This is what we need to think about; particularly as virtual water use in Egypt is growing each year (Nikiel and Elfatih 2021).

Given the limited natural resources, in particular water in Mit Rahina, the only solution to a decline of natural systems is to continue

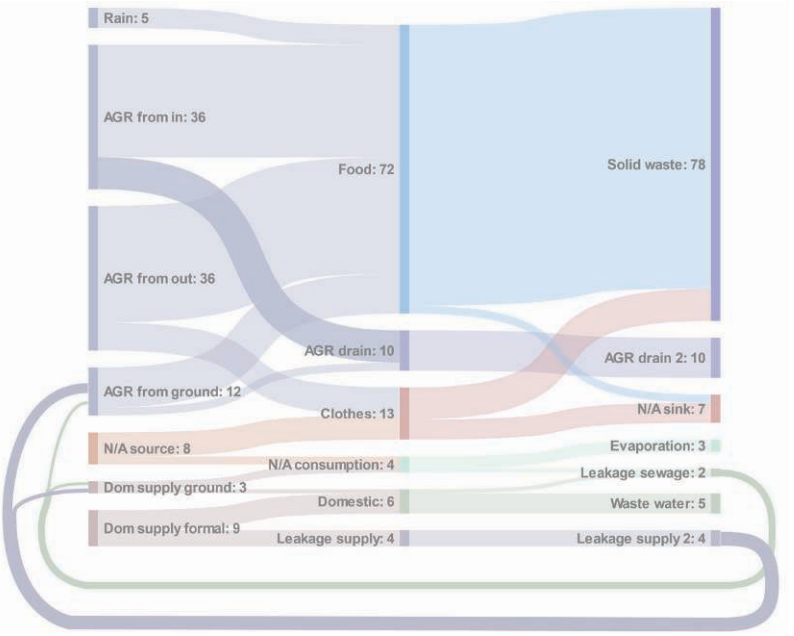

Figure 5. Sankey diagram of the local water system in Mit Rahina.
Source: Nabeel El Hady and Ahmed Tarek.

to support the life of animals and people by turning to a regenerative system. In order to enact this transformation, Mit Rahina needs to be understood as a socio-ecological system that will generate zero waste. First, consumption needs to be more efficient in using the available resources. Second, crucial in this transformation is what comes out of the system, or the materials that are being discharged and that are usually seen as waste. Since nature produces no waste, any process that produces waste is not efficient and needs to be rethought. Our ultimate goal is to mimic nature by creating decomposers that break waste down into basic components that can be utilized by other creatures.

Domestic liquid waste causes direct and indirect pollution to groundwater, soil and agricultural drains. Therefore, it should be given a priority. The lack of drainage systems in most Egyptian villages is caused by many constraints. Decentralized solutions that are ecologically sensitive and save water would be an important step toward a more regenerative water system.

An additional feature must be taken into account: Egyptian villages' organic waste composes roughly 60 per cent of the solid waste generated in Egypt. If this amount is used to create soil and fertilizers to help improve deteriorated soil, it would help address waste and make better use of water locally. Studies recommend a strategic turn toward good-quality organic fertilizers. This process is also important to bring back some of the lost biodiversity in the irrigation canals through the ability to plant native trees and plants on their banks. Removing organic waste from drain canals will improve water quality as well as drainage capacity, which is related to local soil quality.

CONCLUSION

The amount of goods produced since the industrial revolution is huge. The accelerating increase in consumption of 3 per cent a year worldwide (Monbiot 2020), which is higher than the already high population growth, is putting immense strain on the environment, mainly through the amount of waste accumulated in huge dumps or left on the streets. From this waste, only a fraction is put back into the production cycle, thus causing a massive depletion of the earth's finite resources. This irresponsible way of life could rapidly lead to a collapse

of the natural systems essential to the continuation of life for all creatures, including human beings.

Unique local ecosystems require a better understanding and metrics. As we know that producing waste is a symptom of malfunctioning local systems, we need to learn from efficient and functioning ecosystems and from how they produce no waste.

Law 202 seems to adopt ideas that were tested in other contexts but does not address waste properly. The case study of Mit Rahina has enabled us to better understand the challenges facing local socio-ecological systems and could help foster a deeper grasp of how to address waste at the local level.

In Mit Rahina we tried to build on nature's plan for recovery, which is based on the continuous flow of materials and energy from production to consumption and, through decomposition, back to production. We listened to farmers complaining about soil salinity and the impact of heatwaves on crop production, among other challenges facing agriculture. This is particularly important as plants are considered the main producers of food in our ecosystems. And we saw that consumption, while not as intensive as in the Western world, had a significant impact on the natural elements. The lack of local decomposition is particularly manifested in domestic waste discharge and the failure of solid waste management, for instance the open burning of waste or its dumping into agricultural drains. We understood Mit Rahina as a socio-ecological system where people could not be separated from other ecosystem elements. Adopting such an understanding is critical for the efficient functioning of natural systems and emphasizes cultural biodiversity, which is essential for the resilience of the system. The notion of a socio-ecological system is important, not only for the better management of natural resources but also to address issues such as equality and inclusivity, which are sometimes overlooked in ecological studies.

Our water system study for Mit Rahina showed that both liquid domestic waste and solid waste were connected to the water system and needed to be addressed as such. It also enabled us to explore ways to improve the efficiency of the system, starting with waste and focusing on better water quality for both irrigation and domestic use.

Addressing waste in relation to the water system might help transform food production systems. This concern does not only mean using water more efficiently in terms of quantities but also aims at improving water quality through preventing pollution from reaching underground aquifers and contaminating soil. This will help reduce stresses related to the limited amount of renewable water, improve animal and human health and improve agricultural products' safety and quality.

Rural areas are often described as contributing less to climate change than cities. Yet as 86 per cent of water consumption in Egypt goes to agriculture, a finer understanding of climate change puts water at the crux of nature restoration and temperature regulation.

Local, ecological water treatment can help save water and reduce pollution. The local transformation of organic waste can help create good-value fertilizers, which are crucial for revitalizing deteriorated soil. Egypt is a top consumer of chemicals in agriculture; therefore, addressing this issue is urgent. Organic fertilizers are a credible alternative, particularly if a considerable part can be produced locally. This requires more research but has the potential to pave the way for a much-needed transformation in food production in small farms, which form the majority of agricultural producers in Egypt.

We need to save a deteriorating nature if we are to save ourselves and other creatures. A shortcut would be to mimic the natural processes that were perfected through millions of years of evolution, thus achieving the fragile balance that supports our existence on earth. Nature-based solutions, which are low-cost and low-tech, are the main recipe that we can use in Egypt. They might help restore nature in the vast areas suffering from significant decline. But this approach is also based on science, which requires access to data and major support for research and experimentation.

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ERIC HUYBRECHTS*

PLANNING MEGACITIES FACING CLIMATE CHANGE

INTRODUCTION

Megacities are facing major contemporary challenges, including climate change, migration, health crises, the energy transition, disruptive technologies, socio-spatial segregation, socio-economic inequalities and territorial governance crises. Climate change adds difficulties to tackling these challenges in a context of unprecedented levels of institutional complexity. Vulnerabilities related to climate change, such as flooding, sea submersion, landslides, soil movements, water scarcity and heatwaves, put pressure on how to manage territories. Megacities become responsible for mitigating greenhouse gas (GHG) emissions because of their large energy consumption. Accordingly, spatial planning should change dramatically to tackle mitigation and adaptation issues in the face of climate change. The governance structures of megacities cover territories of different scales, depending on their position in terms of economic development, physical agglomeration, organization of services, land and property markets

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and environmental protection. They are subject to levels of complexity that require reinventing their management methods to manage crises.

The main purpose of the present article is to discuss the challenges to and solutions for planning megacities facing climate change. It is based on shared experiences of an international working group dedicated to this topic, managed by the Metropolitan and Territorial Planning Agencies (MTPA) global network in collaboration with UN-Habitat's MetroHUB, Metropolis, ICLEI, C40 and Metrex. This working group gathers a dozen megacities,[1] sharing their practices following the territorial planning shift due to climate change, and is preparing statements on the planning solutions proposed by megacities.

MEGACITIES FACING CLIMATE CHANGE

Climate change has different effects on each megacity, depending on its geography and vulnerabilities. Of the thirty-four megacities that are home to one-eighth of the world urban population (UN-DESA 2019), most are located on seashores and along rivers or big lakes. With the exception of Tokyo, all these megacities are growing. Some of them are growing very rapidly, such as Delhi or Kinshasa, with 850,000 additional inhabitants a year.[2] The more these cities expand, the more they increase their vulnerabilities. According to some extrapolations (Hoornweg and Pope 2017) based on the World Urbanization Prospects 2018 Revision (UN-DESA 2019), there will be fifty megacities in 2050 and eighty-three in 2100, with over two billion inhabitants in total. Megacities can be considered a main feature of twenty-first-century human settlement. The twenty-first century is therefore not only the century of metropolises but also the century of megacities. How do these contemporary artefacts face climate change?

The term 'megacity' refers to population size (over ten million inhabitants), but the definition presents problems for making comparisons when population and job statistics are based on administrative

1. Beijing, Bogota, Buenos Aires, Delhi, the Eurodelta region, Gauteng, Istanbul, Jakarta, Kinshasa, New York, Paris and Sao Paolo.
2. By 2030, the twelve largest conurbations in the world would be, in decreasing order, Delhi, Jakarta, Tokyo, Shanghai, Dhaka, Cairo, Mumbai, Beijing, Mexico City, Sao Paulo, Kinshasa and Lagos.

definitions that differ from one country to another. If we consider a megacity to be a functional urban area (OECD 2012), permanent changes in the built-up area and in economic and mobility areas add obstacles to the delimitation of a megacity. If we consider the administrative side of governing such large concentrations of people and activities, institutional arrangements generally do not correspond to the size of the functional urban area and the related economic and mobility areas. For example, Greater London, with its nine million inhabitants, is smaller than its economic and mobility area of fifteen million inhabitants. Consequently, international comparisons are difficult to make, and researchers generally use proxies based on administrative limits that approximately correspond to their purpose, i.e. urbanization, economic development and mobility, natural resources management, pollution, environmental vulnerabilities, social and spatial inequalities and governance, among others. Assessing vulnerabilities of megacities facing climate change depends on the definition used, which will affect the area to be considered for flooding risks and the related population and activities exposed to these risks.

Megacities are widely recognized as catalysts for globalized, national and international economies. They are part of an interconnected global city network (Sassen 1991). The current shift in the globalization process will probably affect the position of megacities in the international competition between territories. The energy crisis will affect the mobility system of large cities. Facing multiform and frequent crises, their development pattern is being questioned. Their strengths lie in their connectivity, labour market flexibility, innovation, cosmopolitan societies, financial capacities and very large consumer markets. But the concentration of populations makes them vulnerable to air, water and soil pollution, traffic congestion, social and territorial inequalities and environmental crises. And climate change increases these vulnerabilities. Due to their importance for countries, megacities have large responsibilities vis-a-vis contemporary challenges and for offering solutions. Facing climate change, they should reinvent the way they plan and manage their territories.

Megacities highlight important contradictions of the contemporary territorial pattern. Globalization, liberalization of the economy and competitiveness increase social and economic inequalities, with a

higher concentration of wealth in the hands of a few: the Gini indexes of New York, Sao Paolo, Buenos Aires and Gauteng province[3] are above 0.50 (UN-Habitat 2020). City marketing is devoted to attracting investment and talents to compete with other large cities in the world, resulting in the massive eviction of populations from central parts of cities to provide space for real estate investment. The finance economy mainly affects the more profitable real estate assets and urban services of megacities. It fosters gentrification and increases spatial segregation and the polarization of urban development. Empty apartments (20 per cent in China, mainly in megacities) and new ghost towns (Cairo has several) mobilize large investments without benefits for the population. This casino economy affects GHG emissions directly, with cement, steel, sand, gravel, energy and water taken from the natural environment and producing GHG emissions for empty real estate without consideration for social needs.

We can make a distinction between megacities of developed countries, which are very powerful, mainly planned and well integrated into the world economy, and the megacities of the developing world, whose core parts are well integrated into the world economy but whose remaining parts appear to be less well integrated, informal and unplanned. The population of megacities in the Global North is growing slowly, while that in the Global South is growing fast. Because of their size, their spatial structure is becoming polycentric. Their centres are being densified while at the same time, urban extensions create new subcentres to provide nearby services and jobs. Cairo, Lagos and Dhaka are unable to manage rapid urbanization in spite of large investments in infrastructure and new towns.

The impacts of climate change differ between the city centre and the suburbs. The heat island effect is greater in the city centre, where a higher difference in temperature is present. The increasing impermeability of the soil at a large scale, due to urban expansion, increases the effect of flooding by concentrating water flows. Urban extensions put more inhabitants in areas prone to risk, especially in terms of flooding

3. Gauteng province accommodates fifteen million inhabitants within two major cities, Johannesburg and Pretoria. It works like a single megacity.

but also landslides and soil movements. And most megacities are located on seashores, meaning they will be badly affected by the rise in sea level in the future.

DIFFICULT MANAGEMENT OF CRISES

Climate change is becoming one of the main challenges megacities are facing. Several are preparing projects to face flooding, sea submersion, heatwaves and other consequences. The issues faced by megacities are amplified and complex; they represent a considerable challenge for governments and local authorities in terms of management, governance and territorial planning.

One of the distinctive features of megacities is the expansion of urbanized areas beyond the administrative boundaries of the central city or even the region of the main urban agglomeration. In fact, modes of governance are often extremely fragmented by vertical and horizontal divisions between the different levels of government – national, subnational (regional/metropolitan), local (district/municipal/neighbourhood) – in addition to the functional fragmentation of ministries, sectoral fragmentation (water, energy, transportation, housing, health, education, environment etc.) and territorial fragmentation (urban, peri-urban and rural areas). In some cases, this fragmentation can lead to the selective governance of issues and megapolitan spaces according to a spatial division and territorial basis. These complex systems of governance mobilize multilevel and multiactor dimensions to devise and implement territorial policies and strategies. In fact, there is no unified version of the territory; instead, there are different strategies, programmes and initiatives with multiple arrangements articulated around strong and sometimes antagonistic political wills. Multilevel, intersectoral and interterritorial governance takes different shapes in different sectors (water management governance is different from transportation governance or energy governance). The fragmentation of governance systems hinders coordination, which is necessary to limit the impact of natural disasters with their cross-sectoral effects. The more complex governance is, the less efficient it is.

Tentative experiments have been carried out to unify governance at the scale of the megacity. Beijing is one municipality with twenty-two million inhabitants. Greater London adopts a unified system with a

strong representation for an elected mayor. New York does not have a megacity political entity: it extends across three states and more than 800 municipalities. The Paris region covers 70 per cent of the megapolitan area and 95 per cent of the population of the functional urban area, but the extreme territorial fragmentation[4] makes it one of the most complex territorial governance systems in the world. In fact, the institutional sovereignty of the megacity is rarely at the scale of the functional urban area. Therefore, what real capacity do various governance models have to consider the social, economic and environmental challenges facing megacities, especially regarding climate-change adaptation and the management of environmental crises? Despite greater economic resources and political capacities more powerful than those of other cities in the same country, fragmentation weakens megacities' ability to face climate crises. This challenge requires specific governance and coordination mechanisms.

Tensions between the core part of the agglomeration and its peripheries are inherent to large-city management. A powerful central municipality such as Rio de Janeiro, Jakarta or Moscow (which accommodate half the population of their functional urban area) hinders the implementation of a balanced sharing of power and capacities between municipalities. Peripheries suffer from having fewer financial capacities and poorer access to high-quality infrastructure and facilities, a situation that creates inequalities between centres and peripheries. Core parts of megacities can be well equipped to inform the population and take protection measures when a disaster is announced, like in Rio de Janeiro, but this is not the case for most peripheries. The extreme governance complexity of megacities throws into question their capacity to face the challenges of climate change. Their economic and innovation capacities are exceptional, but their governance makes them very fragile in driving their development towards better adaptation and mitigation due to climate change. New frameworks for thought and action are necessary. In this context, territorial planning agencies play a strategic role as supportive tools for

4. Region Ile-de-France, eight Departments, Métropole du Grand Paris (covering 5 per cent of the megapolitan area), sixty-four unions of municipalities and 1,268 municipalities.

decision making for their partners. They become mediators, provide knowledge to feed public debate and devise and monitor megapolitan policies and strategies.

CLIMATE CHANGE AND RESILIENCE

Due to their size and their development pattern, megacities considerably increase GHG emissions. In 2018, Environmental Research Letters estimated that the 100 most populous cities accounted for 18 per cent of global emissions. The dynamics of urban sprawl as well as the use of individual motorized vehicles increase congestion and public health problems. Artificialization of the soil linked to the emergence of these large urban areas also contributes to the reduction of biodiversity on a global scale. These cities' ecological footprint is much larger than their surface areas. London ecological footprint is over a hundred times its surface area, for example (Stats, Maps n Pix 2020). The environmental impact of global warming is amplified in megacities, which are gradually becoming aware of their vulnerability.

Megacities are in the frontline to manage acute crises: air pollution, floods, pandemics, etc. Paris, Mexico, New York, London, Tokyo, Seoul, Bogota, Rio de Janeiro and Lima, among others, are adopting GHG reduction strategies to achieve the ambitious goal of carbon neutrality. Initiatives are multiplying in many different areas through various means (green growth, eco-mobility, 'no net land take', net zero GHG emissions, etc.). They share experiences and experiment with new concepts and innovative projects. But there is a long way to go before a more resilient megacity model is achieved.

The geology, topography, hydrography and location of cities play an important role in the significance of natural risks. As a result of climate change, Dhaka, Lagos, Shanghai, Manila, Guangzhou, Tokyo, Karachi, Rio de Janeiro, Mumbai, New York and other cities are facing rising sea levels and coastal erosion and are at risk of submersion. The intrusion of salt water into the soil and groundwater has consequences such as the destruction of agricultural crops and concrete. The vulnerability of coastal megacities is also increased by the rapid increase in inhabitants living in flooding-prone areas, as well as by the large-scale informal exploitation of the water tables on which these cities (Bangkok, Jakarta and others) were built.

Megacities are mobilized to urgently respond to risks and at the same time prepare long-term actions. Urban planning has to become more resilient and sustainable. Some countries, such as Brazil, have adopted national protection and civil defence measures based on an information and monitoring system for natural disasters. A social, economic, environmental and spatial analysis was crucial to locating the most vulnerable areas and populations. Coordination between different administrations and operators (telecommunications) is essential to anticipate disasters and inform the population in due time. The innovative mechanism developed by Rio de Janeiro has resulted in the adoption of a national plan for the management of and response to natural disasters.

The recent health crisis has led to doubts about the capacity of megacities to overcome longer-term crises in terms of their urban morphology (size, shape, structure, density, centralities), temporalities (concentration at peak hours and in large facilities) and organization of work (teleworking, schedules, teams, commercial and office real estate), including its consequences for residential mobility and behaviours (social distancing, teleworking, telemedicine, e-shopping, residential strategy and public spaces). Territorial planning is dramatically questioned in relation to climate, energy, behaviour and technological transitions in post-COVID-19 times. The health crisis offers opportunities to accelerate changes that are beneficial for adapting megacities to climate change. We can already see that in some megacities, the priorities of local and regional authorities have changed, with an acceleration of the implementation of soft mobility projects (cycling routes) to reduce GHG emissions, a better appreciation of the importance of green public spaces to cool the cities and a reconsideration of the way in which housing is designed in order to face future crises.

MITIGATION IN MOBILITY AND TRANSPORT

Most megacities face higher degrees of congestion, pollution and energy consumption than other cities. Levels are extreme in Delhi, Karachi and Dhaka and Tehran. Urban mobility systems are one of the main causes of these negative externalities, especially in megacities where the level of motorization is high and the car is the main mode of transportation. Crises are times for a paradigm shift. The

COVID-19 pandemic has had a profound impact on transport and urban mobility. Megacities have taken measures (notably teleworking) to reduce overcrowding on public transport in order to limit the spread of the virus. These restrictions have had the effect of considerably limiting the use of public transport and, despite recent measures in terms of both health and distance between passengers, changes in behaviour appear to have impacted passengers' use of this mode of transportation, which dropped during this period. While megacities cannot be efficient without mass transportation systems (train, metro), changes in the mobility behaviour and social organization that have occurred can change the way in which urbanization at a large scale is managed.

Several cities have already introduced new facilities for cyclists and pedestrians. In the Paris region, this has resulted in an additional 650 kilometres of cycling highways to be implemented, while in New York, 100 miles of social and recreational streets were added and in Bogota, temporary facilities widening pavements and cycling paths at the expense of underused traffic lanes were implemented. Initiatives such as these support a gradual transformation of the road network on a metropolitan scale. Examples include metropolitan avenues in Seoul, Paris, New York, Rio de Janeiro or Bogota that have replaced motorways. Some motorways have been replaced by pedestrian avenues (Paris' riversides, for example), changing the quality of life and image of the city. The potential reduction in motorized mobility, linked to the economic slowdown, the significant use of teleworking and the massive modal shift are interesting signals on the modal shift that already occurred in several megacities after reaching 'peak car'.

Several megacities have recently supported Paris' approach of the 'fifteen minutes city' project: a city where, in less than fifteen minutes, residents can access essential services, green spaces and employment. The aim is to bring residents' demand closer to the offer and ensure functional diversity by developing social, economic and cultural interactions. This project also implies integrating a new approach to urban density while increasing the number of meeting and mixing spaces. The reappropriation of this not-so-new concept led to the discovery of new tools for its implementation, with urban services optimized by digital technology and collaboration and sharing practices made possible by the development of digital platforms. These developments

involve new approaches that make it possible to reinvent mobility spaces and rediscover new proximities. The approach should be completed with the 'thirty minutes megacity', based on a polycentric pattern. Furthermore, mobility policies stimulated by temporary experimentations during lockdown or transformations with a highly symbolic charge have met with some success in the heart of megacities and are extended in the peripheries. The mobility pattern shift contributes to reducing GHG emissions by reducing mobility needs.

MEGACITIES' ACHIEVEMENTS IN TERMS OF THE SUSTAINABLE DEVELOPMENT GOALS

Megacities are the result of the globalization development pattern. Their gigantism makes them difficult to govern and amplifies vulnerabilities. They are not planned as megacities, but territorial planning supports coordination arrangements and attempts to offer better opportunities for prosperity and limit negative externalities. Disruptive technologies can offer new opportunities for public participation, integrated planning, infrastructure management, mobility and work management that will impact megacities at a large scale. But their crucial role as leaders of global development and large responsibility for tackling contemporary challenges make their management one of the biggest challenges of the twenty-first century.

Most megacities are adopting climate plans,[5] programmes and strategies to reach carbon neutrality in 2050 and implement projects in different fields, such as renewable energy, eco-mobility, bioclimatic renovation, bio-sourced materials, water recycling and urban canopy. They claim their alignment with the New Urban Agenda (UN-Habitat 2016) and the UN's Sustainable Development Goals (SDGs) through Voluntary Local Reviews or SDG implementation strategies.[6] Their policies have at their core the reduction of inequalities, the tackling of climate change, the promotion of sustainable and resilient cities and access to affordable housing and urban services for all.

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5. For example, PRACC Ile-de-France, adopted in October 2022, with one billion euros of public investment from Paris/Ile-de-France Region for the climate.
6. Cities include New York, Los Angeles, Mexico, Sao Paolo, Seoul, Buenos Aires, Tokyo and Moscow.

While megacities are the main tools of the globalized world and lead the global economy, they have not been able to change the interrelated system that is the result of national policies and international strategies of coalitions of actors. But they prove their ability to provide mitigations paths through innovative solutions in territorial policies that require extraordinary coordination within the complex system of actors. The climate change challenge appears to be an opportunity to change the paradigm for managing and planning megacities.

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LAILA ISKANDAR*

INFORMAL SETTLEMENTS: HOME TO CITIES' PRINCIPAL RECYCLERS/WASTE MANAGERS AND CLIMATE CHAMPIONS

INTRODUCTION

Cities in the Global South have been grappling with how to address the proliferation of informal settlements. They need to apply solutions to contexts that are extremely diverse with regard to location, size, density, building quality, illegality and risk. Their approaches are primarily based on spatial, financial and infrastructure considerations and seldom on economic, social and occupational factors. Tailoring upgrading solutions has become a daunting task for cities.

Gases emitted by waste constitute 3 to 5 per cent of total global greenhouse gas (GHG) emissions. As the linkages between solid waste, informal sector actors and climate change have begun to be more widely understood and appreciated, several global and national policies are being revised. One of the major ways that solid waste contributes to climate change is its generation of GHG emissions.

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The 1.6 billion tons of carbon dioxide-equivalent (CO_2-equivalent) emissions estimated for 2016 are anticipated to increase to 2.6 billion tons by 2050. Emissions from solid waste treatment and disposal, primarily driven by disposal in open dumps and landfills without landfill gas collection systems, account for about 5 per cent of total global GHG emissions (Kaza et al. 2018). The UN-Habitat Waste Wise Cities Tool (UN-Habitat 2021) affirms that recycling is a central pillar in the transition towards a circular economy, in which governments and the private sector cooperate in order to create long-term, sustainable economies. In many ways, recycling is seen as a final effort to effectively utilize resources after people try to both reduce their consumption and find more efficient processes in production. Recycling is a vital way to reduce the environmental impact of natural resource extraction, which is rapidly damaging natural ecosystems. By investing in recycling and transforming already extracted resources, economies can make significant strides in decoupling economic growth from resource use. National and local governments in several countries, such as Brazil and India, have moved in this direction. In Cairo, after the failure of the privatization of waste services by large corporations between 2000 and 2015, the city's informal recyclers (the Zabbaleen) once more provided the much-needed services of municipal solid waste collection, including transporting, sorting and recycling the waste, and did so under imperfect conditions.

Community-based adaptation strategies at the local level enhance the capacity for effective intervention and increase climate resilience. This resilience itself is based on significant, citywide mitigation through recycling. Importantly, it is predicated on long-term synergies between the UN's Sustainable Development Goals (SDGs) and climate change.

This paper analyses six informal settlements in Cairo that have become home to hundreds of thousands of people engaged in an occupation that is critical to the city's public health: the management of municipal solid waste. These neighbourhoods are located at strategic points in the city and currently act as transfer stations that handle 60 per cent of the materials recycling economy of the Greater Cairo Region (GCR). Residents are perceived as garbage collectors, but the only reason they conduct door-to-door collection, transport, sorting and processing is that they are recyclers, i.e., they harvest materials.

INFORMAL HOUSING AND INFORMAL RECYCLING

Addressing informal dwellings should ideally lead to considering how reform proposals impact the informal settlements' continuity in public health service to the city of Cairo, as well as their role in achieving numerous SDGs, namely numbers 1, 2, 3, 4, 5, 8, 9, 10, 11, 15.[1] This should go hand in hand with considering the massive feedstock they provide to formal recycling plants around the country, the trading networks they create with other urban agglomerations of materials in the Delta, Upper Egypt and the two coasts, and their contribution to the reduction of global warming through the lesser extraction of fossil fuels (plastics) and the reduction of other extractive industries (trees to produce paper). In short, addressing informal settlements should provide a broader view of the economic, environmental and social dimensions of their role in the city (UN-Habitat 2010).

Is it possible to imagine such an approach for Cairo? Informal settlement programmes currently grapple with the complexities of incorporating land-use patterns, siting new housing locations, choosing between in situ upgrading and new housing construction, providing infrastructure, mobility and services, and dealing with a host of other urban planning aspects. These programmes seek to improve the physical living conditions of people by using a lens that is currently biased towards housing.

Cairo and other cities in the South (e.g. Dharavi in Mumbai, India, or Belo Horizonte in Minas Gerais, Brazil) have seen informal settlements spring up around specific occupations. The tanners' neighbourhood behind Cairo's aqueduct is one example. The Rod El-Farag vegetable market is another, as are the six recycling neighbourhoods in the city.

The current informal waste system in Cairo has been left to grow and evolve with the organic growth of the city for over seventy years. This system responded with adaptability and agility to the physical growth of the city and the growth of materials in its waste stream. Officials tacitly acknowledged the need to allow traditional recyclers to keep operating the city's waste system and admitted that no other

1. See https://sdgs.un.org.

alternative could operate as regularly. The movement of materials between the informal and formal value chains has positioned waste at a crucial place in both the Egyptian economy and the debate on how materials extraction impacts climate change.

These neighbourhoods have historically emerged as discrete enclaves that soon became assimilated into the city. They now feature dimensions and urban morphologies that are not only linked to the city's physical planning but also to the economic and social development of the country and its population.

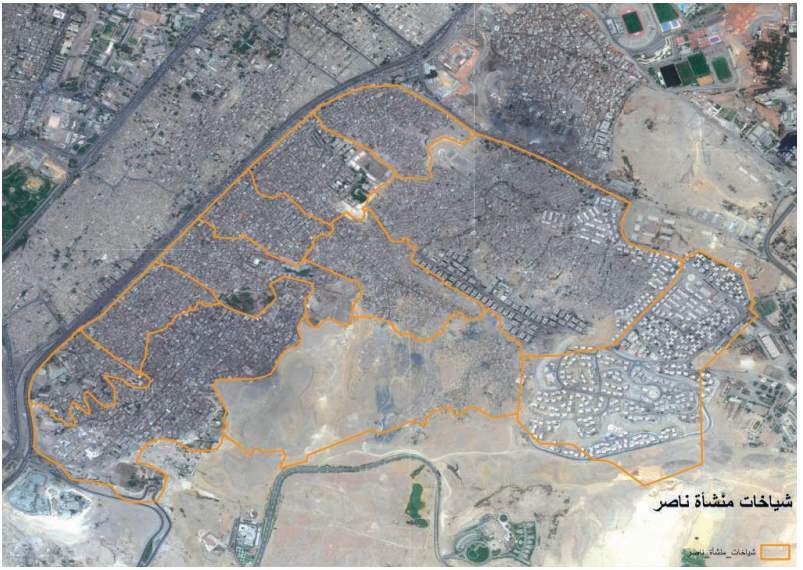

Figure 1. Map of Manshiyet Nasser's nine *shiyâkhat*[2]. Source: MURIS 2015.

A more granular look at the six recycling neighbourhoods of Cairo shows the huge recycling industry that they incorporate. They act as one massive facility, subdivided into thousands of small and medium family-owned enterprises located close to where materials are generated in order to reduce transportation costs, which limits the impacts of GHGs. Dwellings are designed to accommodate sorting and

2. The *shiyâkha* is the smallest statistical unit in urban areas.

recycling businesses on the first floor, while living quarters are situated on the second and third floors. Additional floors provide rental income or serve as storage for recyclable materials when these are in excess or when recycling markets are less profitable because of a drop in prices.

These neighbourhoods – with their land-use patterns, housing construction and spatial planning – were all self-designed, self-built, self-organized and self-financed by the city's informal dwellers. The income from recycling has therefore led to a massive provision of housing stock in Cairo, and it is doubtful whether formal financing, public or private, could have bankrolled that volume of construction. Recycling revenues have also provided vast financing for small and medium enterprises (SMEs) with no access to formal financing institutions. Harvesting the city's materials from its so-called waste has historically acted as a huge financing mechanism for housing, small businesses, transportation and other infrastructure needs of informal residents.

These businesses are intrinsically linked to the public health of the city, the economic and financial functioning of its waste system and the economic development of an informal sector which represents 55 to 60 per cent of the Egyptian economy (Ministry of Planning and Economic Development 2022). By contrast, waste management systems in cities in the Global North have banished sorting and treatment from the heart of the city and have established centralized facilities that are managed and financed through taxation, user fees and subsidies. Their efficiency targets are not based on the number of jobs or local businesses they support but rather on the volume of materials they can incinerate or bury in landfill. This significantly reduces the amount of waste that is recycled.

The number of Cairo recyclers' SMEs grew from eight in 1983 to over ten thousand in 2010 (CID Consulting 2010). This growth was self-financed and self-managed. In addition to collecting, transporting, sorting, selling and processing mixed household materials, these businesses purchase source-segregated waste from commercial and institutional waste generators, roamers, scavengers and intermediaries. They sell these either as end products or as inputs for other manufacturing activities in large-scale industries or small informal enterprises. Through sorting and recycling, they turn so-called waste

Figure 2. European model of transfer station.

into valuable materials that set off a value chain which reverberates across Egypt and beyond. And, remarkably, they recycle 80 per cent of what they collect (Klundert and Lardinois 1995). This happens at great human cost, since these recyclers are exposed to unimaginable health hazards and harassment by a chain of exploiters, from law enforcement to moneylenders and housing agencies. They have a deep experience with exploitation and exclusion.

Unlike formally designed waste management systems, traditional waste management systems are socially constructed and spring from a symbiotic relationship between the people who operate them and their city. They are market-based and derive from local knowledge while providing the most economically challenged residents with incomes, trades and economic growth opportunities. Cairo's informal waste workers achieve the highest recycling rates recorded in cities worldwide and create employment for significantly higher numbers of people than official employment schemes have ever done: seven direct jobs and ten indirect jobs are created for every ton of waste collected (Waste and Skat 2007).

In Egypt, over two hundred[3] formal industrial manufacturing plants contribute to the Gross Domestic Product (GDP), generate employment, and increase exports. This industry relies on the informal economy that moves materials through collection, sorting, recovery, processing and transporting. It is their principal local supplier of feedstock.

3. Federation of Egyptian Industries (FEI) data, 2020, http://www.fei.org.eg/index.php/ar/chambers-ar-1/628-chemical-chamber-ar.

Figure 3. Masaken Othman, Sixth of October. Government housing for residents relocated from Manshiyet Nasser. Source: CID Consulting 2015.

RELOCATION IS NOT THE SOLUTION FOR CLIMATE CHANGE ADAPTATION

In the late 1990s, some of the homes in Manshiyet Nasser were found to be at risk of collapsing off the limestone cliff on which they were situated. Official resettlement plans removed residents to neighbourhoods that had been spatially planned and designed to house people with no particular occupation and therefore did not require space to sort recyclables, store them, or process them. As a result, public spaces were used for these recovery and recycling activities.

Recyclers who were relocated to these neighbourhoods used the physical space around their new 'formal' dwellings to practice their traditional trade. Formal neighbourhoods soon exhibited the same 'squalor' that informal neighbourhoods had displayed. They acquired a bad reputation, and their residents were depicted as people who enjoyed garbage and were immune to its negative health impacts. Transportation costs for the recyclers increased to the point where regular door-to-door service became prohibitively expensive; recyclers soon lost their routes to competing intruders and were downgraded to roamers and bin scavengers on the streets of Cairo.

Official urban planners now find themselves in a quandary, and the negative environmental aspects of informal businesses force difficult choices upon them. Do they move all informal businesses above a certain volume of activity out of the city to new industrial zones and

provide housing nearby, as they did for instance for the Robeiki tanning enterprises? In that model, a large cluster of traditional leather tanners was moved from Cairo to a new, designated industrial zone near the industrial city of Tenth of Ramadan. But does the government have the capacity to undertake such massive, complicated, costly operations, given the need to engage in complex discussions, consultations and negotiations that include legal, financial, physical, social, environmental and economic considerations? Or do urban planners want to explore innovative models of in situ upgrading of informal settlements, based on the businesses created by their residents?

The case of the Cairo recyclers presents unique opportunities for planners to address these issues in a manner which would protect the public health and well-being of the city's twenty million residents. Such a scheme would turn the six recycling neighbourhoods into a distinctly Egyptian model of urban planning that would uphold the neighbourhoods' functions as both recycling transfer stations and residential areas. It would remove the current negative image of the Zabbaleen's work as well as the negative health and environmental consequences of their activity. It would also avoid relocating residents and those small businesses that are non-polluting.

WASTE AND CLIMATE CHANGE

The impact of climate change and the responses to the challenges it poses are closely linked to urban issues. Solving these issues requires a linkage between well-being, prosperity, and adaptation or mitigation. The United Nations' SDGs provide a framework for linking global warming at a temperature between 1.5 °C and 2 °C with development goals that revolve around poverty eradication, reduced inequalities and climate action.

The waste-processing operations undertaken by the Cairo recyclers and other urban poor constitute adaptation options that reduce the vulnerability of these communities while increasing the city's resilience. What is not managed by the urban poor ends up in landfills or unmanaged dumpsites. Current practice shows that open burning is expected to triple from 49 million metric tons in 2016 to 133 million metric tons in 2040, increasing the release of toxic gases (such as methane) and chemicals and doubling plastic leakage into the ocean.

Figure 4. Plastic: a major threat to biodiversity and a factor of climate change. Source: Center for International Environmental Law.

This discussion confirms the findings of the Intergovernmental Panel on Climate Change (IPCC; see Pörtner et al. 2022) that targeted development planning across the range of innovation and investment in social policy. Nature-based solutions and grey/physical infrastructure can significantly increase the adaptive capacity of urban settlements and cities and their contribution to climate-resilient development. The report also points to how urban adaptation measures provide opportunities to contribute to climate-resilient development pathways that enhance social capital, livelihoods and human and ecological health and contribute to low-carbon futures. Urban planning, social policy and nature-based solutions bring great flexibility, with co-benefits for climate mitigation and sustainable development.

This requires governance structures and processes to respond to those urban populations currently living in informality, beyond the direct reach of formal climate policies (Satterthwaite et al. 2018). The Cairo recyclers are evidence of the necessary emergence of an informal urban 'green economy' in the absence of formal service provisions. Not only does this green economy provide the city with a critically important service, it is also efficient and low-carbon (Brown and McGranahan 2016). Keeping the Cairo recyclers close to the heart of the city is therefore an important policy decision that is directly related to urban planning and the environment.

These insights from the waste sector suggest that adaptation pathway approaches for 1.5° C futures need to combine considerations of inclusiveness, site-specific solutions and urban/environmental justice mechanisms in order to achieve climate and urban justice.

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HEBA ATTIA MOUSA*

THE MAKING OF THE EGYPTIAN CYCLING SCENE

INTRODUCTION

Human-powered mobility (walking and cycling) is a basic mode of mobility that has been long overlooked in favour of motorized modes. However, after years of cities around the world being planned around the needs of private car owners, the downsides of this extreme motorization of cities are presenting themselves: a fragmented urban fabric, reduced quality of life and increasing levels of air and noise pollution. This, paired with the growing awareness of climate change, has caused a global comeback of walking and cycling to the practice of urban planning and design.

In Egypt, there are small attempts at several decision-making levels to promote cycling as a mode of mobility. On the national level, the Ministry of Youth and Sports has started two initiatives to subsidize bicycle purchases for youth via affordable instalments. The names of the initiatives reflect the objectives behind them: the first is called 'your bicycle, your health' and the second 'your bicycle, your profession'.

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Additionally, different cities and governorates have launched local initiatives aiming to introduce bicycle facilities (bikeways and parking). Civil society and international organizations have also contributed to the physical infrastructure of cycling, providing bike-sharing systems, bike parking and bicycle lanes in several cities, in cooperation with the government. All of this reflects political leaders' support for cycling, especially after many events during which Egyptian president Abdel Fattah el-Sisi showed his support for cycling and led cycling parades himself.

However, investment in cycling infrastructure and serious policies encouraging cycling are still very limited in current urban planning and governance structures. It seems that planning for cycling exceeds the present capacity of most local administrative units (the governorates). Moreover, a paradigm shift from motorized mobility to a mix of modes of mobility is yet to be adopted and practiced in modern Egyptian cities, or maybe revived, as cycling was a normalized mode of mobility in these cities in the past.

Civil society and cycling groups have been active in mobilizing and promoting cycling mobility despite cultural barriers, whether these are gender or class-based. In this environment, Tabdeel was born as an advocacy group and a bridge between the planning and policy spheres and civil-society activities. Tabdeel employs an ecosystem approach to cycling advocacy that covers the different spheres influencing cycling mobility. The following paragraphs discuss these spheres in order to provide a holistic overview of cycling in Egyptian cities.

THE BUILT ENVIRONMENT

Egyptian cities vary in terms of urban form and quality of infrastructure. In general, however, the older cities provide a mix of land uses and urban density as well as a flat topography which constitute good preconditions for cycling. The bigger cities in Egypt, such as Alexandria and Cairo, have commuting lengths that can be a barrier to cycling. In these cities, using cycling for local and first- and last-mile trips is an advantage in terms of time and affordability. However, cycling remains risky in most parts of Egypt, and cycling infrastructure that provides safety and direct access to bike users is a pressing need.

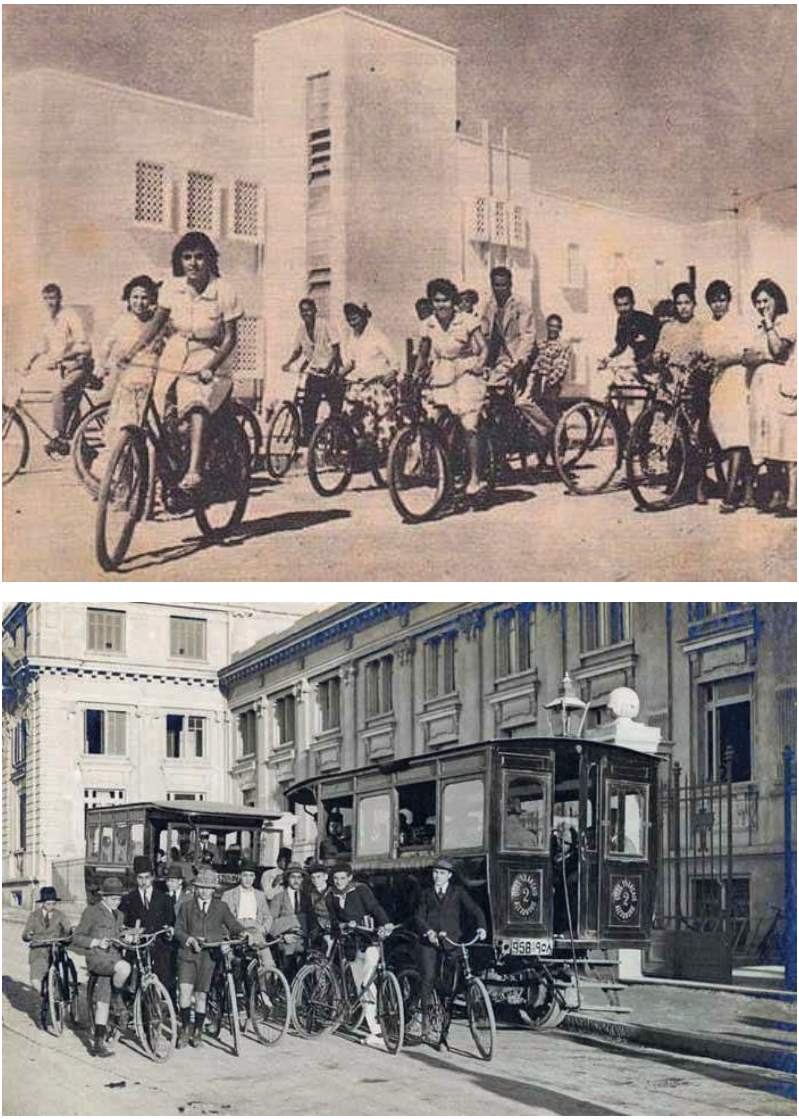

Figure 1. Two examples of cycling being used as a daily mode of mobility. Right image: Women working in a textile factory in Qena commuting by bicycle after their workday – 1962. Left image: Students of the French school in Alexandria posing with their school bus and bikes – 1920s. Source: Left image: photographer unknown; right image: Mission Laïque Francaise.

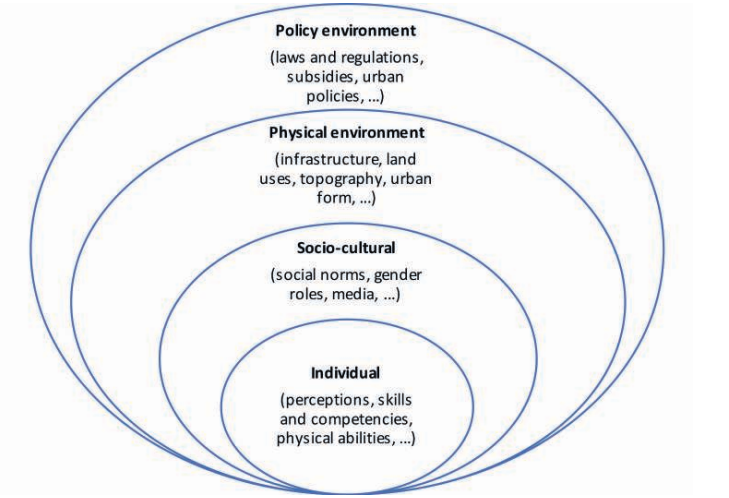

Figure 2. Ecological framework for cycling mobility. Source: Based on Sallis et al.'s (2006) framework for active living communities.

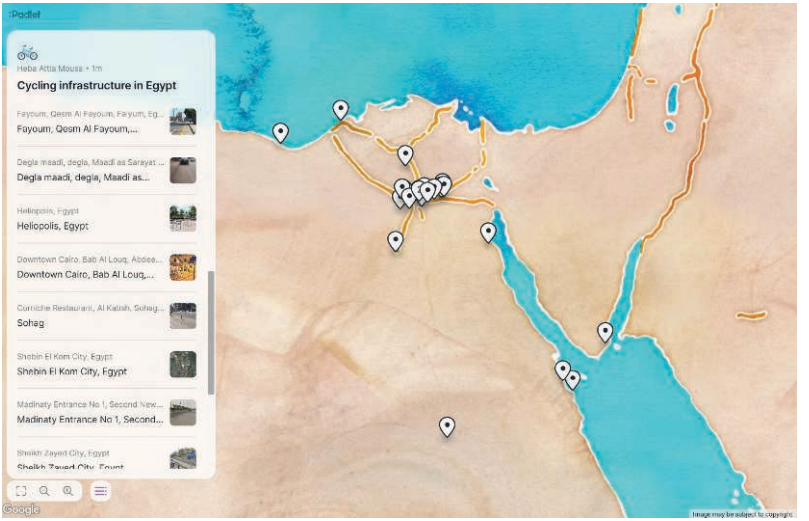

Figure 3. Mapping of cycling projects in Egypt. *Source: Tabdeel* (https://padlet.com/hebaaamousa/1zoehtfaw7yocwdu).

Tabdeel mapped twenty-five projects located all over the country. The majority was located in the Greater Cairo Region (GCR) and the new cities around it, while nine projects were located in other cities.

More than half of all cycling projects (52 per cent) were located in new urban communities and touristic resorts, where the advantage of short distances and mixed land use are absent. Some of these projects are privately funded, such as the bike-sharing system of Al Rehab compound or the bikeway network of El Gouna. Being on privately owned land also means that access to some of the existing cycling facilities in Egypt is exclusive to certain groups of tenants, owners or tourists. Meanwhile, most cycling hotspots in Cairo's old city lack any cycling facilities. Therefore, justice in the distribution of the cycling infrastructure is a topic that needs to be addressed.

Some cities outside the GCR saw more investment in cycling, which included multiple project types: the Fayoum Sustainable Transport Programme (STP) project, for example, included bike-sharing at Fayoum University and bike lanes on the city's streets as well as the provision of a cycling network in Shebin El Kom. Recently, UN-Habitat initiated the first bike-sharing system in downtown Cairo, accompanied by a pilot cycling lane in addition to existing bike parking facilities.

The bike-sharing systems in downtown Cairo and at Zuwail University and the cycling infrastructure that was implemented in Fayoum and Shebin El Kom were the only projects that deliberately aimed to compensate for the limitations of the mobility system and provide solutions for first and last miles or a service complementary to public transportation. The remaining cycling projects did not have a clear purpose in terms of contributing to the urban mobility system, and some of them – such as the cycling lanes in Sheikh Zayed and the Sixth of October cities – were oriented towards recreational cycling.

THE SOCIAL ENVIRONMENT

When people hear the word 'cycling', it normally brings up a certain image: an environmentally conscious lifestyle, a cool sport for young, fit middle-class citizens, or maybe an everyday tool that provides an affordable mode of mobility. Associating cycling with niche lifestyles, such as eco-friendly lifestyles, sports groups or any subculture, can

form a barrier to mainstreaming cycling as a mode of mobility (Larsen 2017). For cycling to be part of our cities' lives, we need to normalize and depoliticize it. The 'otherness' associated with different cycling groups might fragment collective advocacy and marginalize certain groups in any participatory process.

In the Egyptian context, cycling has long been attached to poverty and a low social status, mainly after it lost ground to cars, which were made into a status symbol by returning Gulf migrants from the 1970s onwards. Even though only a minority of Egyptian families own a car, car ownership has been a long sought-after dream for most Egyptians (Amin 2001). Another association people have with cycling is that it is a children's activity (Puttrowait 2014).

In terms of gender norms, cycling is exclusively associated with men. This, in addition to the restrictions that female bodies face in public space, is reflected in the share of female bike users, who constituted only 1.2 per cent of all users in 2021 (Attia Mousa, Alahwal, and Aboutaleb 2021). Research from the delta city of Kafr el-Sheikh showed that this gender gap starts at an early age: from all kids between 6 and 11 years old who used a bicycle, 80 per cent were boys and 20 per cent were girls. This causes a gap in competencies and skills that grows bigger with time (Elfiky 2010).

In recent years, the rise of recreational cycling groups changed some perceptions of cycling and introduced new identities and representation in the media, social media and the streets. The weekend rides that started among middle- and upper-middle-class youth are gender-inclusive and provide a degree of protection for female bike users, who face less harassment in a group and are encouraged by peer support. The group's visible and growing presence in the streets has contributed to the normalization of cycling women in some middle- and upper-middle-class neighbourhoods. However, in most parts of Egyptian cities, cycling remains stigmatized and is seen as taboo for women (Attia Mousa, Alahwal, and Aboutaleb 2021).

Cycling groups have another added value for bike users: they make streets safer. Research in public health and road safety shows that fewer collisions happen between cars and bike users if more people are cycling (Jacobsen 2015). Motorists tend to adjust their behaviour according to the dominant group on the street. Therefore,

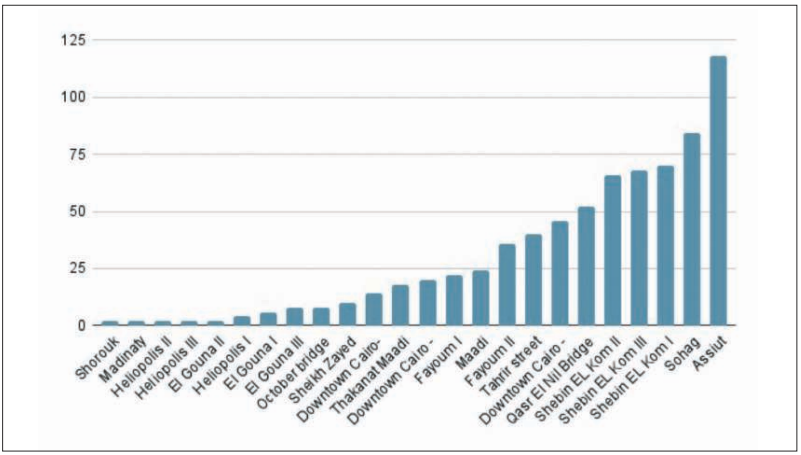

Figure 4. Bike rider count per location per hour. Source: Street count by Tabdeel's team.

the more people cycle, the more other people view cycling as safe. This phenomenon is called 'human infrastructure'. Human infrastructure refers to how people interact with each other and with their city and how they form networks and shape power relations in the streets. It is the most crucial part of the shaping of a cycling scene in any city.

The bicycle count conducted by Tabdeel's team in the course of 2020 and 2021 revealed some cycling hotspots in Egypt that are not necessarily linked to physical cycling infrastructure. For example, counting bike users near Assiut's train station proved that this location has the highest share of bike users per hour of all counting locations across the country. There are fewer bike users in more populous locations such as downtown Cairo or Heliopolis. This puts Assiut on the map as an Egyptian cycling city, whereas new cities – like Sixth of October and Sheikh Zayed, which have dedicated physical infrastructure but no people cycling – are not viewed as cycling cities.

THE POLICY ENVIRONMENT

Cycling planning in Egypt is a field open to a variety of stakeholders. Around 43 per cent of cycling projects are the product of multistakeholder collaborations between different sectors, while others

Figure 5. School bike parking in Assiut where students use bikes as a main mode of mobility. Source: Photo by Yusuf Halim.

Figure 6. Workers in Port Saiid during their morning commute. Source: Photo by Hesham Gamal.

had one main initiator. The public sector, for example, set up 25 per cent of projects, while the private sector initiated 32 per cent of them.

Projects by the public sector involved either national authorities, such as the Ministry of Environment, the Ministry of Youth and Sports and the New Urban Communities Authority (NUCA), or local government entities, such as governorates and city councils (e.g. the Nozha street cycling lane in El Shorouk). The National Service Projects Organization (NSPO) was involved in implementing the cycling lane on the Cairo–Ain Al Sokhna highway.

Civil society and international organizations have been active in initiating cycling projects and mobilizing funds. For example, the Sekketak Khadra bike parking project in Cairo was coordinated by UN-Habitat and implemented by local NGO Green Arm – Nahdet El Mahrousa. They secured funding for the project from the Embassy of Denmark. In rare cases, cycling groups were the main initiator of a project. For example, a devastating accident in 2018 on the Cairo–Ain Al Sokhna road motivated sports group Maadi Athletes to contact the national company for roads, buildings and development to implement a cycling lane along the road, which was named the longest cycling lane in the Middle East and North Africa. Although this lane did not meet the safety requirements for cycling infrastructure on a highway, it was a good example of grassroots action and mobilization towards recognizing cyclists as being part of the street.

The private sector has also contributed to cycling projects in Egypt. Orascom, Talaat Moustafa and Sodic have implemented bikeways and bike-sharing systems in some of their megadevelopments, including El Gouna, El Rehab and Beverly Hills. The bike-sharing systems in these compounds are implemented and operated by Egyptian cycling start-ups Stebn and Baddel. In some cases, bike-sharing systems in private developments were funded by banks through their Corporate Social Responsibility (CSR) departments, such as CIB and NBE. In new cities, including Sixth of October and Sheikh Zayed, NUCA required private investors to accommodate cycling lanes and sidewalks around their developments.

Funding is essential in setting up cycling infrastructure projects. Bike-sharing revenues for example should not be dependent on users' fees, since the lower the rental price is, the more bicycle use is encouraged.

Instead, they should depend on advertisements at bike stations. If this operation and its maintenance are not set up in this way, the service provider (i.e. Stebn or Baddel) takes responsibility and ends up depleting its resources. It is then no longer able to sustain the project. Success cases of efficient bike-sharing as described by these companies can be found at private universities (e.g. Zweil University) and high-class compounds (Beverly Hills), as they have running funds that cover these costs.

Urban laws and regulations as well as law enforcement can facilitate cycling by imposing traffic safety, planning standards and financing mechanisms for cycling mobility. In Egypt, some laws regarding cycling exist yet are not enforced because of social or political obstacles. However, it is still necessary to develop laws and regulations that promote cycling mobility in Egypt (Alahwal and Aboutaleb 2022). Tabdeel has financed research on urban cycling laws in Egypt, on which Table 1 is based.

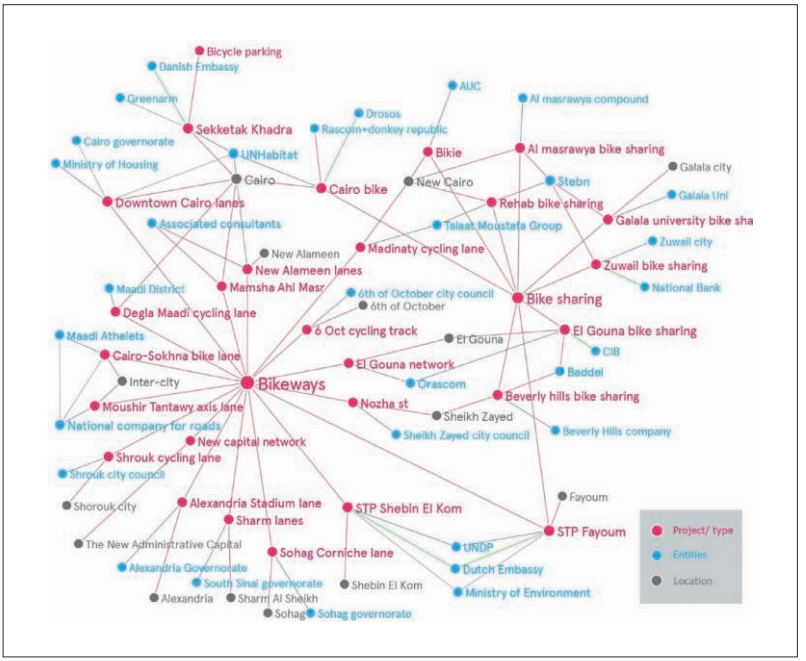

Figure 7. Mapping bicycle projects in Egyptian cities and the involved entities. Source: Tabdeel.

Table 1. Urban cycling laws in Egypt. Source: Tabdeel, based on Alahwal and Aboutaleb (2022).

Traffic law number 66, 1973	
Bicycle and riders' definition	The law classifies bicycles as low-speed vehicles and states the need for cargo bikes to have a licence. It also prohibits cycling on public roads and renting bikes to children under 8 years old. It prohibits bike rental in general if the necessary permit is not obtained.
Use of the street space	Regarding the use of streets, the law states that bicycle users are required to ride on the right side of the road, except when there is a cycling lane in other parts of the road; in this case, they are obliged to use the cycling lane. It also prohibits bicycles from riding side by side.
Riders' behaviour	The law prohibits riding using one hand, carrying cargo loads or sharing the bike with another person except if the bicycle is designed for this purpose.
Safety	The law requires bicycles to have front lights with yellow or white shades with a range of ten metres and rear lights with yellow or orange shades. It does not require the use of helmets while cycling.
Bicycle design	The law recognizes only the use of bicycles that have at least one handbrake and metal frames made from one piece, with no bolts and joints, which excludes folding bikes, wooden bikes, aluminium-frame bikes, fixed-gear bikes, and bikes with pedal brakes.
Egyptian code for urban roads and highway works, 1998	
Integration of bikeways	The law requires the implementation of bikeways when the annual average daily traffic of bicycles exceeds 500. The code also specifies that bikeways should be 1.10 metres wide. The code describes three types of bikeways: (1) paths separated by a vertical level or distance from car traffic, (2) paths separated by physical separators or paint and (3) lanes shared with car traffic with signs for bicycle use.
Motorized traffic speed	The law requires traffic-calming measures in dense urban areas but does not elaborate on the required speeds or characteristics of streets this rule applies to.
Financing cycling infrastructure	
NUCA's 3 per cent policy	NUCA requires private developers to contribute with development exactions that can be oriented towards developing cycling lanes, sidewalks and leisure facilities. In Sixth of October, it coordinated the development of cycling infrastructure using this requirement.

Under development

The Housing and Building Research Centre in Egypt has formed a committee of urban mobility, planning and cycling experts – including members of academia, civil society and the public and private sectors who advocate for cycling planning – to write 'the Egyptian code for cycling infrastructure'. The code is under development and the results are to be approved after the contents are finalized.

Egyptian cities have a long way to go before they will be cycling cities. However, there is noticeable progress on the physical, social and policy levels. The continued efforts from the public and private sectors as well as cycling grassroots organizations will eventually lead to a better environment for cycling and accelerate the attraction of new bike users who would otherwise be reliant on motorized mobility. In 2022, with Egypt hosting the UNFCCC Conference of Parties (COP27), a few impactful cycling projects made their way to downtown Cairo and Sharm El Sheikh. The newly established bike-sharing system in downtown Cairo (Cairo Bike) is an especially pioneering model of a project that aims at mainstreaming cycling as a mode of mobility and targets a modal shift in short trips. In a context of increasing fuel prices for motorized mobility and a growing awareness of its health and environmental issues, cycling is set to gain more ground across the country.

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URBAN INCLUSION AND ENVIRONMENTALLY RESPONSIVE ARCHITECTURE: CREATING A WOMEN-FRIENDLY SPACE IN IZBAT AL-BURG, DAMIETTA

INTRODUCTION

As the urban population continues to grow, understanding ecosystems in the city has become increasingly important and is now a rallying cry for action to respond to and mitigate the repercussions of growing urban sprawl. Urban areas echo a rather harsh image of concrete jungles with impoverished ecosystems and a disconnection between the built and natural environments. Although the current trend towards urbanization repeatedly manifests this visual image – putting the viability of our cities into question – it is imperative to challenge this narrative by tackling what is native and non-native, green and concrete, and also addressing urban areas as major contributors to climate change. This narrative frames a discourse on the 'quality of space', which includes biodiversity protection, health and well-being in the city, urban inclusion and resilience as crucial factors in the dramatic transitions taking place.

To address this discourse and its value, this paper focuses on a localized public space intervention based in the coastal city of Izbat al-Burg, Damietta Governorate. Located along the Nile River and the Mediterranean Sea, the city of Izbat al-Burg demonstrates layers of complexity: it was shaped by landscape and architecture, influenced

by historical events and industrial activities and coloured by what has become endangered biodiversity. Despite inevitable changes in the urban population and city fabric, the city's conglomeration of layers provides ample testimony to its rich story. Harnessing an inclusive and community-driven approach, the intervention focuses on the implementation of micro-scale acupuncture to mobilize the immediate context and capture the potential and power of the ripple effects of a widespread urban transformation.

Through a process of place-making, Takween Integrated Community Development (TICD)[1] conducted a multidisciplinary study to map and express the context's hybridity in order to conscientiously develop an environmentally and gender-sensitive design.

AREA PROFILE

Izbat al-Burg is a city located 15 kilometres north-east of Damietta Governorate and 210 kilometres from Cairo Governorate. Izbat al-Burg covers an area of 2.65 square kilometres with an approximate population of 50,000 inhabitants, based on data from the Central Agency for Public Mobilisation and Statistics (CAPMAS 2017). Administratively, it falls under the auspices of the Damietta Administrative Centre or *markâz*; one of five administrative centres in Damietta Governorate. Ras al-Bar is a resort city on a peninsula on the coast of the Mediterranean Sea. It is located opposite Izbat al-Burg and bordered to the west by the Nile; it also falls under the auspices of Damietta Administrative Centre. The landmark known as the Lissan in the northern part of Ras al-Bar is where the Nile and the sea meet. Ras al-Bar covers an area of 3.76 square kilometres with an approximate population of 10,000 inhabitants, based on CAPMAS (2017). Its population increases tenfold in the summertime due to local tourism.

1. Takween Integrated Community Development (TICD) is an urban development company established in 2009 in response to a foreseen growing demand for innovative urban solutions in a world where it is predicted that by 2030, 60 per cent of inhabitants will be living in urban centres. Takween specializes in the development of integrated packages in urban development services and solutions to support and complement efforts to tackle urban challenges.

Izbat al-Burg is the region's major fish production centre. Up to 63.7 per cent of its labour force works in agriculture and fisheries (see EEAA 2005a, 2005b, studies conducted for the Support for Environmental Assessment and Management [SEAM] Programme).[2] A large part of the city's area is covered by Lake Manzala, with scattered settlements surrounding its periphery. This leaves the picturesque city with very little room for urban expansion.

HISTORICAL AND SOCIO-ECONOMIC BACKGROUND

The city of Izbat al-Burg was named after a defensive tower, *burg*, that historically safeguarded the city from invasions that it was susceptible to due to its strategic location. In the eighteenth century, a military fortress was built (now known as Ahmad Urabi Fort, or Tabiyyet Urabi). Its remnants lie in a dilapidated condition today. The land surrounding the fortress covers a large area of Izbat al-Burg and was recently fenced in by the Ministry of Tourism and Antiquities, due to its importance as a cultural heritage site. In 1869, a famous, fifty-five-metre-high lighthouse was built in the city to guide ships in the Mediterranean Sea. Izbat al-Burg is known for having the largest shipyards in Egypt and is the main industrial city for boats and ships. The craftsmanship of manufacturing and maintaining them has been passed down for generations (Teller Report 2018). The city's location shaped its history and economic activities, where the majority of the city's male residents are fishermen.

PROJECT BACKGROUND

The Safe Cities programme is a UN Women's Global Flagship Initiative (UN Women 2018). Its full name is 'Safe Cities and Safe Public Spaces for Women and Girls'. It aims to promote an integrated, community-based approach to addressing issues and forms of violence against women and girls in public spaces. The programme works through members of the community to empower women and girls, raise awareness and provide technical support to make public spaces

2. Support for Environmental Assessment and Management (SEAM) is a regional programme geared towards strengthening decentralized environmental management and improving environmental planning and services for the poor.

safer and improve quality of life. UN Women Egypt works in partnership with the government and civil-society organizations. Its scope of work falls within the National Strategy for the Empowerment of Egyptian Women 2030, which puts forward a road map for the implementation of the Sustainable Development Goals (SDGs) 2030, especially Goal 5 – concerned with gender equality – and Goal 11, concerned with sustainable cities and communities. The 'Creating a Women-Friendly Space' project in Izbat al-Burg, Damietta, is implemented through a partnership between the National Council for Women, the Damietta Governorate and UN Women Egypt, with the support of the Kingdom of the Netherlands.

PROJECT AREA

Tucked away in the heart of Izbat al-Burg, with a panoramic view of the Nile, is a 2,000-square-metre public open space in the vicinity of the Egypt Public Library, adjacent to the city council (*maglis al-madina*) and within a walking distance from the city's central hospital. The site is located opposite two primary schools, one for girls and the other for boys. Facing Ras al-Bar city, the project site can be accessed by two ferries, and it was found that both cities serve one another regarding public services, recreational areas and commercial activities.

The library's construction work was suspended in 2011, and it was not until 2019 that the construction activities resumed. Abandoned for several years, the project site was left to deteriorate, becoming an unsafe territory in proximity to a vulnerable community. The resumption of the library's construction work rekindled a glimmer of hope for its long-awaited grand opening and its catalytic importance to the city. The public library is part of the Egypt Public Library Initiative and Fund, which intends to provide a space for students at all levels of education to enhance their skills, build the capacities of its residents and support art, cultural and social activities. The library's construction and public space upgrading focus particularly on women and children and are part of the Damietta Governorate's strategy to develop informal and unsafe areas into accessible and empowering public spaces that facilitate equal access to opportunities. The Egypt Public Library is recognizable in Izbat al-Burg's coastal skyline and forms an anchor point that not only attracts visitors from its immediate context but

also from the surrounding villages. To support and complement the library's activities, the surrounding public open space presented an opportunity to create a women-friendly space that caters to the needs of the local community.

STEPPING STONES TO A TRANSFORMATIVE INTERVENTION

MULTIDISCIPLINARY STUDY AND FINDINGS

To develop an in-depth understanding of the targeted area, Takween conducted a multidisciplinary study at the meso- and micro-levels of the urban context in early 2020. Our studies defined an appropriate catchment area and included the documentation of land uses, accessibility, transportation and mobility, public space activities, environmental studies and a safety audit. Takween carried out a participatory needs assessment by engaging stakeholders to identify the major issues regarding public services, with a specific focus on educational and recreational services, utilities and the safety and security of women and children. Focusing on Egypt Public Library's target users, women and children from different geographic locations between the ages of 25 and 60 and 6 and 18, respectively, were selected to participate in the study and inform the analysis and design programme. The process encouraged community involvement, especially for groups that are often underrepresented.

The findings provided a clearer insight into the immediate context. The studies identified low levels of safety in the surrounding area due to the library's construction and widespread illegal activities. Other challenges present were the physical deterioration of the built environment, including inadequate lighting, deteriorated paving etc., as well as high groundwater levels due to the site's proximity to the Nile.

Students enrolled in nearby schools commuted with their mothers or alone, and most women were interested in acquiring additional skills to increase their family's income, as their husbands often worked abroad. Indeed, Izbat al-Burg's fishing industry has been facing challenges due to the activity's dependency on a seasonal calendar in addition to the recent surge in prices for fuel and ship maintenance. As a result, many fishermen were put out of work and struggled to carry the financial burden to sustain their livelihoods. Other

male-dominated economic activities include the production and manufacturing of wood as well as agriculture and raising livestock. After multiple participatory meetings, it became clear that there was a lack of economic and recreational activities for women and youth.

AN INTERACTIVE SAFE SPACE: TACKLING URBAN INCLUSION AND ENVIRONMENTALLY RESPONSIVE ARCHITECTURE

After obtaining a thorough understanding of the library's intended use and the multidisciplinary study, the design vision focused on providing an interactive and safe public open space for women and girls. The space responds to the local community's needs and the surrounding environment and was designed with a gender-sensitive approach to accommodate cultural, educational and recreational activities.

The design strategy involved clustering the public open space into groupings of public-private activities. To make use of the unutilized area, a private yet visually connected pavilion was designed to house a multipurpose space for workshops and exhibitions, providing a safe space for knowledge exchange and socio-economic opportunities.

Figure 1. Existing conditions before implementation – Egypt Public Library and its vicinity. Source: © Takween Integrated Community Development 2021.

Adjacent to the library is a light wooden structure, designed to serve as a reading space/technology-friendly area. It constitutes an outdoor extension of the library with a panoramic view of the garden. Located in one corner is a theatre intended primarily for cultural activities and performances, and at the other end is a play area, providing a safe and interactive space for children.

Responding to the community's needs, the public open space facilitates the social and economic development of the area. Women and youth are provided with the opportunity to improve their skills by attending vocational training, which encourages female entrepreneurs to participate in local exhibitions, ultimately creating a space for innovation and growth. Addressing the need to enhance public safety, an integrated approach was implemented for the physical upgrading of the surrounding environment by providing adequate lighting, improving the site's accessibility and cleaning up the riverbank by eradicating activities such as solid waste dumping, illegal activities etc.).

Through low-impact development (LID)[3] principles, the public open space has several environmental and economic benefits. Permeable paving was installed to increase infiltration, mimicking a natural process; suitable surfaces were provided for pedestrian use while allowing rainwater to infiltrate the ground. The total coverage by impervious surfaces was vastly reduced by relying on permeable paving and natural landscaping, mitigating run-offs and heat absorption. The landscape was designed to suit the site's high levels of groundwater and salinity. Cyperus papyrus was chosen for its ancient symbolism and to capitalize on the discovery in 2000 that it was growing in the wild once again. Due to the site's exposure to the sun, horizontal spreading trees were selected to allow for shade without limiting visibility.

The Nile serves as a constant reminder of the importance of *water* as a resource and the exacerbating impacts of climate change on our cities. In any stage of development, implementing LID principles

3. Low-impact development (LID) principles refer to the land-use management strategies that emphasize conservation, the use of on-site natural features and site planning to minimize impervious surfaces, native vegetation loss and stormwater run-off (DEC n.d.).

is possible, which implies managing water in a natural manner to improve water quality, reduce energy usage, increase recreational activities and improve urban health. Many case studies have shown that LID principles are a promising way of mitigating flood and erosion impacts. Given the concerns regarding the impacts and challenges of climate change, the project intervention embodied the value of shifting to and adopting some principles of LID as a stepping stone to a much larger framework.

Inspired by Damietta's local architecture, a careful selection of sensitive and non-invasive materials was made. The pavilion was designed with rope partitions – an aesthetic material that is locally sourced and an effective means of social control and maximizing visibility (to see and be seen at all times). To protect the structure from external environmental conditions, sandwich panels were installed at inclined angles to enable the flow of rainwater. The reading area was designed with operable wooden louvres, encouraging users to interact with the environmentally responsive structure. Other treatments involved the use of exposed brickwork, adding texture and a bold statement to the design while responding to a familiar architectural language in the city.

CONCLUSION

The project's haven gave Izbat al-Burg's community a much-needed breathing space and gave a voice to those unheard. It provides a safe and communicative space for knowledge exchange and socio-economic opportunities. In a broader sense, safety represents an urban tool for not only physical protection but also the governance of educational, recreational and community capacity development while understanding the diverse needs of women, men, boys and girls. Safety should be regarded as a more inclusive tool for the development and security of communities by giving individuals the power to contribute to their community's resilience – the ability to withstand, adapt to and recover from disturbances. Quality of life becomes an important indicator, addressing concerns around urban health and community well-being. The power of such localized acupuncture lies essentially in the relief it provides to communities and the spreading of awareness of time-sensitive adversities, thus supporting better resilience and encouraging behavioural change. Given climate change, the rapid urban transformations

Figure 2. Pavilion rope partitions and surrounding permeable paving/pervious surfaces. Source: © Takween Integrated Community Development 2021.

Figure 3. Reading area designed with operable wooden louvres. Source: © Takween Integrated Community Development 2021.

Figure 4. Sunset view from Egypt Public Library. Source: © Takween Integrated Community Development 2021.

taking place and the increasing pressure on the livelihoods of communities, breathing spaces have become essential. By triggering a chain reaction, these spaces lead adjacent urban environments to adopt similar frameworks to regenerate neglected areas, deploying transformative strategies on an urban scale. Within this framework, a narrative is developed: the qualities of pocket spaces and interventions are an integral component of contributing to and propelling the profound discourse tackling public space, well-being and biodiversity protection.

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AIR POLLUTION AND CLIMATE CHANGE: TWO SIDES OF THE SAME COIN

INTRODUCTION

This chapter is about climate change and sustainable cities. Its title is 'air pollution and climate change' because air pollution and climate change are two sides of the same coin. They have the same source, namely the burning of fossil fuels, whether in transportation, in factories, to heat homes or for any other activities which use fossil fuels as sources of energy. The majority of these activities is concentrated in cities.

The burning of fossil fuels emits not only carbon dioxide and other greenhouse gases (GHGs) but also other contaminants and hazardous substances that pollute the air we breathe. These include sulphur, nitrogen oxide, ozone, carbon dioxide, minerals and, most importantly, particulate matter, or PM.

PM is composed of a combination of different kinds of pollutant gases, droplets, minerals, dust etc. The chemical composition of particles differs according to type of fuel, activity and location. PM is very harmful to human health, and the smaller its size, the more

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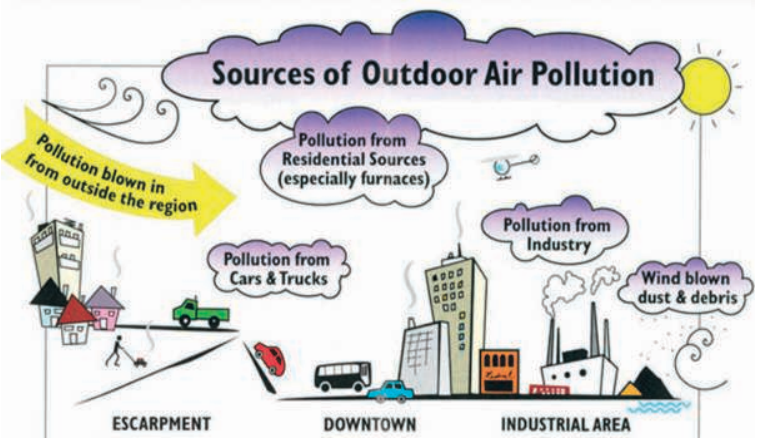

Figure 1. Sources of outdoor air pollution. Source: Clean Air Hamilton (https://cleanairhamilton.ca/sources/).

harmful it is. Small particles inhaled from the air can penetrate the body and affect different organs. Air pollution can cause a variety of diseases, from simple inflammation to cancer.

The way most cities are built – with tall buildings, busy centres, narrow streets, high population densities and rare green and open areas – increases the health burden of air pollution. According to the World Health Organization, outdoor air pollution is responsible for more than three million early deaths every year; the majority in developing countries (WHO 2016).

Cairo is a megacity, with more than twenty million inhabitants. It is a very compact, busy city with traffic congestion, few green areas or open spaces and many industries. A few years ago, Cairo was the second most-polluted city in the world, according to the WHO (2016). In 2015, the average concentration of particulate matter ($PM_{2.5}$) in the air was 80 μgm/m^3, while the level recommended by the WHO is 5 μgm/m^3 (WHO 2021).

Alexandria, the second largest city in Egypt, is very vulnerable to climate change too, both because of its location on the north coast and because of its high levels of pollution. It hosts about 40 per cent of Egypt's industries and, with ten industrial zones and their economic activities, the city's production heavily relies on fossil fuels.

Figure 2. Air pollution, the silent killer. Source: World Health Organization (https://www.who.int/thailand/health-topics/air-pollution#tab=tab_1).

MITIGATING CLIMATE CHANGE

Some may say that Egypt is not responsible for most emissions, since it produces only 0.6 per cent of global emissions. Moreover, they say, Egypt is not historically responsible, so it should not make an effort to decrease fossil fuel consumption (mitigation), especially because it needs to grow and create economic prosperity.

In reality, however, Egypt will hugely benefit from reducing its fossil fuel consumption and shifting to cleaner fuel. This will not only decrease GHG emissions but also air pollution, which hits the country hard. The economic and health costs of air pollution are very high. In 2016, the number of early deaths from air pollution was 60,000,

Figure 3. Smog over Cairo. Source: Egyptian Streets blog (https://egyptianstreets.com/2018/03/24/cairos-environmental-crisis-tips-for-the-average-cairene-to-tackle-air-pollution/).

reaching 90,000 in 2019, with a cost of 2.8 per cent of GDP for the economy (Larsen 2019; WHO 2016).

Compared to other countries undergoing the same level of economic growth, Egypt ranks high on emissions, which translates into a high burden for public health and natural resources. Egypt needs renewable energy, and it can be more efficient in using its fuels and quicker in its transition to renewable energy. This will directly benefit Egypt as well as the world as a whole.

WHAT NEEDS TO BE DONE

Much good work has been done to mitigate climate change in Egypt and hence decrease air pollution. Projects have included increasing the share of renewable energy in power generation, encouraging the use of LED for lighting, introducing electric buses, replacing old taxis with more efficient cars and encouraging the use of natural gas

by cars, improving efficiency in production and consumption, and improving roads.

However, many projects contradict each other, and good effects achieved by one project can be undermined by another. For example, huge projects undertaken to improve roads were mainly carried out without simultaneously improving public transportation, creating bike lanes or considering the urban and pedestrian needs of the city. Meanwhile, many trees and green areas, already rare in Cairo, were removed for the sake of widening these roads. Another example consists of projects to improve the industrial efficiency of fuel consumption: the benefits of these new forms of production are reduced by the construction of new industries that heavily consume fossil fuels, such as cement (in spite of an oversupply). Reclaiming land for agriculture also consumes a lot of water, while changing the wasteful irrigation system used in old lands may give better results.

There are many examples. We may conclude that there are efforts in the right direction, but we still need an inclusive strategy or vision to mainstream the environmental and social dimensions together with the economic one in all economic projects in order to accomplish sustainable development, mitigate climate change and improve the health of the population.

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AHMED EL DORGHAMY*

HEAT ISLAND EFFECTS AND CITIES

I'll be talking about the heat island effect (HIE) and the impact it has and how this is related to climate change but also what we can do to address this.[1] When I was on my way over here today, I saw something interesting. I saw a bird gliding, not fluttering its wings, but gliding for about two or three minutes as we moved along, and it was completely stationary while it was moving. And as someone who was going to talk about the HIE, I was aware of what was happening. This bird was moving over convection currents. Essentially, the sun hits the ground – the jungle of asphalt, the jungle of concrete – and this city is emitting it back and radiating a lot of this heat. This is also creating convection currents, which provide lift for something like a bird that you would see not moving its wings. Gliding is also a hobby, where you can glide for hours with an almost race plane. This is always a very interesting thing to reflect on because as much as something like this is fascinating, it's also telling us a lot about a very serious problem that we are facing today.

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1 This contribution is transcribed from an oral intervention at the *Facing climate change* conference.

In a nutshell, HIEs occur when you have when a city that is losing its vegetative cover. And what is it being replaced with? Non-permeable, non-pervious surfaces – asphalt and concrete and so on. Research has proven that this is associated with increased cases of deteriorating cardiovascular diseases, respiratory diseases and many other illnesses. So the next question is, why is this related to climate change? As we all know, climate change has a lot of impacts. But what if there are further impacts or further phenomena that exacerbate things or make them worse? As we learned before in the previous panel,[2] for example, when we talk about sea level rise, there's also something people are doing today that only make things worse, such as excessive extraction of groundwater or the silt that's being held back by the high dam and so on, which is further exacerbating an existing problem. And this is what we've observed in the past. So, what does the IPCC report say about what's going to happen in the future? To be concise, the extreme events that used to happen maybe once every ten years are now happening two to three times every ten years and will accelerate. So, the propensity for catastrophe is higher.

But we also have the problem that most of the population is living in cities now. As you walk around, imagine that since 2008, half of the world is living in cities, but in the next fifty years we're going to have 80 per cent of all people living in cities. This is why this is getting more and more attention. So even the researchers and leading thinkers that are working on addressing rural issues are all looking into the city. For example, the Food and Agriculture Organization (FAO) is now looking at cities as well and launching programmes like the Green Cities Initiative. Suddenly, even those who've dedicated their lives, their research, their work and their profession to the rural areas see that 80 per cent of the world is going to live in urban areas. This means that the current state of affairs cannot be sustainable. It's not just climate change that would impact us; it's also the way we're going to design our cities. What we have now happening around the world is a quick response by solving the problem itself or breaking down the problem and solving each issue. For instance, how would you address

2 On metropolises, fragile deltas and vulnerable territories.

the HIE in cities? The answer might be partly through recovery of surface vegetation, a sort of urban nature. But we're not just talking about the surface, the streets or the spaces between buildings but also about rooftops. This is a concept that's spreading like wildfire now around the world, in many cities. It turns out that the more attention you give to the materials you use on your surfaces, the better your city will cope with this phenomenon.

Then some new concept starts emerging, such as heat equity. As you can imagine, this is related to the unjust distribution of the impact of HIEs. This is another issue that cities are now racing to address, such as having special programmes dedicated to vulnerable groups of society that would be most affected not just by climate change but by what we have done to our cities to accelerate or magnify this challenge. Let me move on to the projects that are being done, focusing for the sake of time on one sector as an example. This is a sector that we're working with a lot in UN-Habitat – sustainable mobility. The question is, what is the relation between sustainable mobility and the HIE? Take a walk after this event. You'll see that the spaces between buildings are now becoming entirely asphalt and sidewalks. There's very little green space. We are losing space to private cars; about 200,000 cars are hitting the roads every year in Egypt. We're losing about four football fields worth of space every week in Cairo, as an example. This is space that should rather be dedicated to spaces for children to play in parks and other services in the city or just spaces in the city for people to enjoy the urban experience. This is what we're seeing every day, and we see this in all cities around the world.

We heard a little bit about Jakarta and the challenges it's having with the rise in sea level, but Jakarta itself as a mega city, or Manila or Mexico City – they're facing similar problems, accelerated loss of public space, but not just to the favour of cars but to the favour of asphalt and concrete. We've been designing our cities for a while, so among the solutions is to mitigate this problem through improving our provision of alternative modes of transport. This is exactly what we're doing as we advocate projects such as the promotion of cycling and its different forms and bike sharing and so on to diversify the solutions. This is not trying to diversify the solutions of mobility but rather to enable people to move from their cars to a diversified lifestyle

of mobility. Here we see hope in reducing our need for asphalt and for the jungle of roads and bridges. We've been starting to see it in many cities and towns. The key takeaway here is that if we start looking at each sector, we're going to find a lot of solutions. Mobility is probably among the most prominent areas where we can address this issue, which is very much related to climate change and its impact on the unjust distribution of its impact.

As we move forward, we can also start addressing new challenges that are coming on our agenda. If you look at the conflicts that are happening now and in Europe, everybody is talking about this. If it had not been for the preparation over the past couple of decades to have resilient cities, there would have been much more significant problems like food shortages, among other things. More than ten years ago, I was actually involved in an upgrade project in some of the biggest power plants in Poland, Turkey and Iraq. These were coal power plants. As I see how things are unfolding now, I am realizing how much impact something that was done so many years in advance has had in building a resilient city. Back then, it was for climate change, not for an energy crisis.

At the end of the day, resilience is the same thing as it is to show how this activity undertaken more than ten, fifteen years ago is today really serving resilience in the current energy crisis. The provision of district heating in the city is possible because the power plants there were to a very large extent catering to heating at the city level. Here I'm venturing into another sector, which is the power sector – heating and cooling and so on. As we look at all the different sectors and at building a resilient city, we are not only building resilience for climate change and heat islands but also for any further crisis that we might face in the future. If we rewind again and look at the key messages that we are advocating, it is ensuring that the future is one that is less dependent on private cars in fewer cities that are in less need of more and bigger roads and bridges. We want to ensure solutions, such as green roofs, that can create a lot of green jobs and diversity the urban nature to cater to the biodiversity that lives with us in the city. It's not just human beings but all the diverse species that we need to take care of.