# TEL AVIV AND CLIMATE CHANGE:

# AN EXAMINATION OF THREE IMPACTS AND THEIR IMPLICATIONS FOR RESILIENCE AND GEO-POLITICAL STABILITY

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As climate change becomes an increasingly prevalent issue on the global agenda, more and more cities are recognising the essential necessity to respond to the challenges and implications of climate change facing their urban and peri-urban populations now and into the future. For the city of Tel Aviv- Yafo in Israel, experienced climate change impacts will require developing responses that are not only sustainable and develop resilience, but also eases pressures of geo-political instability. This examination will discuss three climate change impacts expected to have dramatic consequences for the city: Climactic weather changes, Sea-level rise, and intensified water insecurity, and will explore how Tel-Aviv-Yafo and Israel as a whole, navigate both current challenges of climate change and future implications that these impacts will have. A discussion of Israel's overarching policies, documents and commitments will also be presented, with an extended discussion of the security implications of climate change for the country.

The city of Tel-Aviv-Yafo is one of unique circumstance, an amalgamation of two cities. One, Tel-Aviv, founded in 1909, the other, Jaffa, established more than 3,000 years old. It is a fast moving, dynamic city, recently labelled one of the world's top 'smart cities' (Steinmetz, 2018) and its well-known reputation globally, for having its finger on the pulse. City population statistics show a continuous growth rate averaging 1.1% yearly, with recent inhabitant figures in 2016 at 438,700 people (Municipality of Tel-Aviv-Yafo, 2018). As climate change intensifies, the challenges to maintain stability for this growing urbanised city will become increasingly important, sustaining centric societal systems of health, economy and the environment. How and to what extent Tel-Aviv-Yafo is acknowledging and attending to climate change impacts will be discussed below.

One of the most pressing problems facing Tel-Aviv-Yafo and Israel as a whole, is the unavoidable change in climatic weather patterns. Like many cities around the world, exacerbated vulnerability due to increased heat and precipitation changes will affect societal systems, water supply and demand, and sustainable agricultural management and Tel-Aviv-Yafo is no different. In their examination of climatic trends in Israel, Kafle & Bruins (2009) established a 99.5% significance level in increased annual temperature rise of 1◦C between 1998 – 2002 for the city of Tel-Aviv-Yafa, proclaiming global warming within the region would lead to drier bio-climatic conditions, with ramifications for human and environmental health. Whilst increased heat has been presented as an unequivocal and inevitable impact of climate change, changes in precipitation trends for dry and arid areas are not as once assumed. Precipitation rates have been sighted as remaining largely equal, if not slightly higher for the Tel-Aviv-Yafo area. This has been contributed predominantly to its coastal locality and influence from oceanic systems such as the North Atlantic Oscillation (Ben-Gai et al, 1998). Reduction in precipitation rates will affect areas mostly outside of the Tel-Aviv-Yafo district, resulting in increased stresses on agricultural farming lands and water hydrology, which will, in term, indirectly impact the resilience capacity of the city and equally the country in its demand for resources (Kafle & Bruins, 2009; Ziv et al, 2014). OECD (2013) estimates a decrease in precipitation of 10% by 2020 and 20% by 20150, with an increase in desertification in the southern part of the country. Alternatives in water management will need to be sought with extensions in further irrigation and desalination recourse.

Whilst the Mediterranean Sea provides somewhat positive reverberations for precipitation patterns for Tel-Aviv-Yafo, rising sea-levels attributed to climate change is inescapable and will have significant consequences on the city's landscape and its populations for the coming future. It is expected the encroachment of water will severely impede coastal beach use, leading to erosion issues and gravely impact coastal stability (Leatherman et al, 2000). Estimated projections state a possible sea-level rise of 0.5 meters by 2050 for the Mediterranean area, and possibly reach to one meter by 2100 (OECD, 2013). Due to inconsistent historical monitoring, long-term rates for sea-level rise change in Israel are unreliable, if not unavailable (Rosen, 2000), however studies from other locations on the Mediterranean coasts have confirmed a rise of almost 10mm/year, resulting in a retreat of the Israeli coastline by 2-10 meters per 0.1-meter rise (Klein et al, 2004). Sea-level rise predictions are still in early stages, and climate modelling remains imperfect, however, Lowe & Gregory (2010) maintain that serious consideration and attentions is required on this topic and its imminent consequences of global cities.

In addition to climatic weather changes and increased sea-level rise, water security will be a centric concern for Tel-Aviv-Yafo and Israel, a country that is already consuming more than it can naturally supply (Thi Hoang Duong et al, 2011). The OECD (2013) estimates Israel's annual water deficit at more than $300m^3$/year and that water scarcity will be exacerbated by climate change impacts of increasing regional temperatures, overall regional reductions in precipitation rates and escalated sea-level rise, harming critical mountain aquifers via reduced recharge and coastal aquifers via increased seawater infiltration (Gabbay & Brachya, 1999; Pe'er & Safriel, 2000). Melloul & Collin (2006) notes that while Israel has a varied high and low topographic coastline, and impacts may be minimal to the north of the country, sea-level rise will still have a significant impact on low lying areas such as Tel-Aviv-Yafo. Increasing climatic changes will also impact the hydrological cycles of the Lake of Galilee, aquifers and other water supplies that fed Tel-Aviv-Yafo via the National Water Carrier (Thi Hoang Duong et al, 2011).

In light of the three presented climate change impacts predicted for Tel-Aviv-Yafo, the challenge going forth for this city and Israel as a whole, lies in the substantial and proactive planning of adaptive and mitigative measures and actions (Kafle & Bruins, 2009). A relatively slow starter in the climate change arena, in spite of its ratification of the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 (UN, 2018), Israel is still in the starting blocks of its mitigative efforts to address climate change and reduce greenhouse gas (GHG) emission contributions. The continuous yo-yoing in administrations has led to tepid responses in policy creation and implementation, leading to inconsistent execution and results. Israel's 2011 climate change policy issued intentions to significantly increase its funding allocation for mitigation actions (MoEP, 2011) and in 2015, Israel initiated a holistic analysis on national GHG emissions in order to report reduction potentials and submitted it to the UNFCCC, committing to a reduction of 7.7tCO2 by 2030, a commitment lower than recommended by the committee however (MoEPa, 2016). They later signed the Paris Agreement in 2016, verifying to the international community their commitment to tackling this global problem. The Israel National Plan was drawn up later that year, outlining mitigation plans in areas of Energy, Transport and Housing, with planned targets to reduce by 17% in electricity consumption, 20% reduction in transport emission outputs and an overall target to shift electricity generation to more renewable sources (MoEPb, 2016). Whilst mitigative plans and actions contribute to minimising the impact of global warming of less than 2◦C, these actions should not be pursued in isolation. In light of the above climate change impacts presented, extensive adaption measures are required in order to prepare Tel-Aviv-Yafa and the nation for forthcoming impacts that will considerably reduce the city, as well as the country's resilience capacity.

Israel's adaptation planning, in relation to mitigative efforts has been well documented since 2009, however implementation efforts have been limited. The Israeli Climate Change Information Centre (ICCIC) was established in 2011 to inform on the preparation of the national adaptation program. It has produced several documents and recommendations for the implementation of a national adaptation plan, in spite of the absence of any tangibly recognised action plan to date. The ICCIC recognises the need to identify knowledge gaps and capacity limitations for both national and local levels, in accordance to current climate change circumstances. It highlights water resource security as a primary concern, both now and into the future, and have advocated for key investment in water-sensitive planning at a national level and urged city's like Tel-Aviv-Yafo to increase and continue initiatives that raise public awareness of water issues, addressing water saving and pollution management and promote the transition to using grey-water where possible.

In addition to water security concerns, the ICCIC also identify increased regional temperatures will lead to increased health concerns for the growing population of Israel. Recommendations on a national level to increase monitoring and coordinated response for extreme events is necessary, with a simultaneous strengthening of social and health services. Local vulnerability to climatic temperature increases have equally been recognised, as almost 90% of Israel's population lives in urban and peri-urban areas. For Tel-Aviv-Yafo it will be important to address issues of urban heat island effects, pollution, and waste via urban planning to mitigate and adapt to future effects of rising temperatures and precipitation changes (MoEP, 2014).

Whilst the ICCIC adaptation report recognising the risk of sea-level rise it does not present any recommendations nationally, other than establishing risk maps that will enable local level authorities in their efforts to assess their own vulnerability and act accordingly. This somewhat feeble attempt of direction at the national level may explain the lag of activity for the country as a whole, however at the local level, the city of Tel-Aviv-Yafa has shown its own proactive and independent responses to potential climate change risks, perhaps an accord reiterating the call for cities to control their own coasts and adaptation plans (Lidman, 2016).

Tel-Aviv-Yafo's self-determination is demonstrated through various acts such as joining the C40 Cities Climate Leadership Group in 2017, in a bold effort to exhibit the city's commitment to climate change action. It is already a member of the 100 resilient cities, committed to the Milan Urban Food Policy and has long engaged with the Global Covenant of Mayors for Climate and Energy (C40, 2017). Due to its fast-growing urbanisation and the unavoidable implications that come with it, Tel-Aviv-Yafo has long promoted initiatives that lessen the stress of population growth, whilst simultaneously addressing environmental and climate change concerns. The city's municipality has stimulated transitions to low carbon lifestyles by encouraging residents to cycle more by providing increased bicycle infrastructure, in addition to supplying a public bike-share scheme, the Tel-O-Fun. Tel-Aviv-Yafo residents are also well connected with public transport systems both within the city with Dan Buses and throughout the country via Egged. While these initiatives and systems may show a positive direction toward a transition to a low carbon future and climate change awareness, the current realities of the city are not all optimistic, with many of the population still maintaining carbon heavy practices. Tel-Aviv-Yafo's growing population will undoubtedly challenge the municipality and national policy makers in finding a balance between future growth and development ambitions and mitigating climate change implications. Despite current circumstances and challenges, the city continues its slow move on its transitional path with further investments into Tel-Aviv-Yafo's first metropolis light rail, set to be completed by 2021, with aims to reduce much needed traffic congestion and significantly reduce GHG emissions (Municipality of Tel-Aviv-Yafo, 2018). The city, a proclaimed smart city, is also targeting resilience building

for its residents by engaging with ICT's via a personalised DigiTel card enabling up to the hour communication regarding city concerns (Municipality of Tel-Aviv-Yafo, 2018).

Although findings show a conscious effort to transform the transportation sector, little information is available for improvements or adaptation efforts that address coastal security and sea-level rise for the Tel-Aviv-Yafo coastline. Lidman (2016), comments this is largely to do with the outdated division of authority over waterways in Israel and that the newly amalgamated authority over several beachfronts between Bat Yam and Herzliya by the Atarim company may herald new future collaborations between the private, local and national levels to begin addressing and managing climate change adaptive action.

Climate change will, without a doubt impact cities with serious implications for social, economic and environmental spheres. For Tel-Aviv-Yafa, and Israel as a whole however, there is an additional factor that requires consideration when discussing current and future climate change impact implications for its population, Security. Geo-political security has become a growing concern in climate change impact analysis, in which many argue an increasing correlation between climate change and conflict within the already unstable region (Feitelson et al, 2012; Gleick, 1993; Podesta, 2008; Starr, 1991). The concept of security and emerging discourses of 'securitization of climate change' has provided a new arena for old perspectives, with little knowledge of future outcomes (Messerschmid, 2012). The arising discourse identifies water insecurity as centric in this link with climate change, and is posited to severely unsettle relations between Israel and Palestine, with further potential to disrupt regional relations if this issue is not adequately addressed and planned for. Transboundary resources shared between Israel and Palestine, and Israel and Jordan will indeed need delicate attention and cooperation to manage necessity requirements and political expectation. How Israel will navigate these relationship is yet to be seen and can only be monitored closely going forth.

This paper has provided an examination of the city of Tel-Aviv-Yafo and Israel's mitigative and adaptive responses to three chief climate change impacts. An exploration of the implications of changing weather trends, sea-level rise and water insecurity was presented both in relation to local city and national country levels. Research found significant trends of increased regional temperatures, paralleled with decreased precipitation rates would lead to elevated stress on social systems, water security and agricultural management. Notable sea-level rise was also determined as a prime risk for the city of Tel-Aviv-Yafo with levels to rise to one meter by 2100. Future water security was posited as a third and centric concern for the city and country in connection to increasing weather trends and sea-level rise. How these three climate impacts will affect the future of the city is still largely hypothesised, however, it is argued that proper and adequate planning is required to mitigate potential impacts. A review of policies, documents and commitments were put forward to provide an overview of past, present and future engagements to assess to what extent the country is addressing climate change and its risk adequately. It was found that while the country showed tepid attitudes to mitigation and adaptation, the city of Tel-Aviv-Yafo endeavoured to move forward independently in its commitment as a smart city, preparing to increase resilience for impending hardship associated with climate change. While the three main implications of climate change were presented for Tel-Aviv-Yafo, an additional component of geo-political security regarding water security was presented as a growing implication of climate change for the future. It will require close monitoring and transboundary cooperation between states in order to avoid any escalation of regional instability. Climate change and its implications for Tel-Aviv-Yafo and Israel will undoubtedly be complex and the severity of those impacts will rely on integrated applications of mitigation and adaptation to address the city's current limitations and transition the city to a truly resilient one.

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