

Assessing the economic ramifications resulting from climate warming in the city of Tel Aviv-Yafo

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An ounce of prevention is worth a pound of cure Benjamin Franklin

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Climate change is increasing the frequency and severity of extreme weather events worldwide, wherein extreme heat surpasses other climate-related disasters in terms of fatality rates. The World Economic Forum points 'failure in climate action' and 'extreme weather events' as the gravest global risks, both in immediate and prolonged contexts.

Cities' population is especially exposed to this threat due to the urban heat island phenomenon, and the effects of climate change are disproportionately felt in urban economic and social marginal communities. The Middle East, along with Asia, are the areas where many cities are already experiencing high temperatures today, and the number of days with high temperatures and the extent of heat waves will increase significantly towards 2050, and these are also areas where the most significant damages are expected. Although cities cover only about 1% of the earth's surface, they bear the responsibility for about 80% of the gross global product, consume about 78% of the energy supply and produce more than 60% of the global greenhouse gas emissions. Consequently, the implementation of an advanced urban climate policy holds exceptional importance.

This study investigates the implications of the warming of the urban space in Tel Aviv-Yafo on various economic aspects of the well-being of the city's clientele (including businesses, tourists, and residents) and the economy of the municipality, in 2050 (in monetary terms of 2021). The reference to the effects in the middle of the century embodies a good balance between the quality of the predictions and the uncertainty. Not only that closer reference year would not have significant differences between scenarios, but it would not offer a real possibility to fundamentally changing the face of things, since the processes that have taken place until now largely determine the situation until the middle of the century, while the actions that will be taken in the coming decades have a real impact potential about the years after 2050. This study examines two distinct warming scenarios – the Representative Concentration Pathway (RCP) 4.5 and 8.5 scenarios, which appear as two central scenarios in different forecasts, are sufficiently different from each other and are also used in the forecasts of the Israeli Meteorological Service. This work deals with the quantification of damages because of the rise in temperatures, only. Specifically, this research focuses solely on quantifying the damages stemming from temperature increases, while other climate change events such as floods, sea level rise, fires, and droughts lie beyond the purview of this investigation, despite the interconnectedness of these phenomena.

This study conducted an extensive review of diverse information sources that examine the issue of urban warming from various perspectives, including a global outlook, regional and state-level analyses, urban-centric investigations, and thematic analyses. The comprehensive literature review provides a detailed account of anticipated effects and potential methodologies for quantifying them. The research primarily focuses on specific domains such as health and well-being, energy, economic development, and ecology, employing a bottom-up approach. Additionally, a top-down approach is employed to quantify projected damages as a percentage of GDP.

Based on the findings from the literature review, a refined set of relevant parameters was identified. Afterwards, whenever feasible, the data was extrapolated to align with the conditions of the urban economy in Tel Aviv-Yafo. The economic quantification is based on macroeconomic parameters and the price level of the research year (2021), and an adjustment was made for the projected increase in the population for 2050 assuming other variables remain constant.

It is important to emphasize that the research in this field is still in its infancy, and the economic estimates are partial, resulting in a limited evidence base. In addition, most of the existing studies consider various climatic risks, yet, in this study we focus only on the aspects of warming. Another constraint is the lack of consistency in the available data due to the absence of standardized methodologies and research approaches employed within the field, resulting in substantial variance among findings. In addition, there is an uncertainty regarding long-term socio-economic conditions, which makes it difficult to predict the direct and indirect economic effects of climate warming. Given the study's limitations and its preliminary nature, a cautious approach was adopted in generating estimations to enhance the reliability of the findings.

To facilitate the calculation process, an estimate was conducted using market prices such as energy costs, and according to an estimation of external costs such as in the areas of mortality and morbidity. It is important to note that both analyses are preliminary and schematic, and are based on existing research and the ability to adapt it to the city's data. Therefore, it is crucial to recognize that this economic quantification does not encompass the entire spectrum of economic impact on societal welfare and well-being. Nonetheless, it serves as a foundational economic reference point that can be utilized for the formulation of policies, establishment of priorities, and informed decision-making processes.

The economic assessment demonstrates that the cost of the damage in the city of Tel Aviv-Yafo from climate warming in 2050, factoring the anticipated population growth, ranges from 2 billion NIS per year, under the RCP4.5 scenario, to 4 billion NIS per year, under the RCP8.5 scenario. Bottom-up quantification of the direct damage components accounts for approximately 50% to 75% of the estimated total damage, drawing on established research data and information.

The disparity between the outcomes derived from the two assessment methodologies can be attributed to two primary factors:

Firstly, the estimates regarding GDP loss usually encompass climatic effects that are beyond the scope of this work, such as floods, fires and sea level rise, which are responsible for example for most of the expected damage to infrastructure.

Secondly, bottom-up quantification incorporates only the "known-known" effects – effects supported by robust research that quantifies the effect of warming, ensuring the reliability and comprehensibility of the economic evaluation. The quantification according to this method does not include many effects that are expected to cause additional damage, including ecological damage, lack of water resources, damage to trade and the economy and derivative financial

risks (such as the denial of credit to climate-vulnerable businesses). Furthermore, costs resulting from climate-induced migration and crime are also excluded from the quantification.

The internalization of the urban heat island phenomenon is expected to double the estimated damage in 2050. Moreover, it is essential to acknowledge that the distribution of damage is non-uniform both in terms of affected populations and geographical regions. Therefore, it is expected that the main damage, especially in terms of health, will be in the southern parts of the city.