

## Article

# Options and Strategies for Planning Water and Climate Security in the Occupied Palestinian Territories

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**Abstract:** (1) Background: Water security is at the front and center of climate change, human security, and sustainable development in regions and communities with competing water usage contexts, climate change effects, and cross-border water-sharing agreements, resulting in conflicts arising. Shared water agreements are affected by geopolitics, segregation, water availability, and access rights. Climate change can worsen water problems by changing precipitation trends or causing droughts. (2) Methods: Document and content analysis and primary and secondary data assessment were used to develop spatio-temporal patterns. In establishing a water security narrative for the region, the selection of SDG 6 (water) and SDG 13 (climate action) targets and indicators was also evaluated. UN-Water's 2013 water security conceptual framework was used to examine water and climate security concerns and give a set of principles to assess gaps and fulfill needs toward a 'water security future' for communities and states in the region. Also, hydro-political perspectives in the region or state were evaluated using discourse analysis and guiding notes from emerging scholarship to support suggestions and prospective solutions toward mitigating water insecurity and risks from climate change and disasters, including resource (water) related conflicts. (3) Results: Hydro-hegemony keeps the water sector in one state under massive stress, and the lack of consensus-building for the regional water agenda continues to breed conflicts between communities and states. (4) Conclusions: We reiterate that the escalating water and climate crises will deepen, and at the national and local scale for OPT, the restrictions and geopolitical tensions about shared waters can render coping and adaptation mechanisms for people and stakeholders challenging.

**Keywords:** climate security; water security; Occupied Palestinian Territories (OPT); transboundary; indicators; Sustainable Development Goals (SDGs)



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## 1. Introduction

According to the recent Intergovernmental Panel on Climate Change assessment report on climate dynamics, significant changes in temperature and precipitation patterns, as well as increases in the frequency and severity of climatic extreme consequences and events, pose one of the greatest hazards to humans and ecological systems [1]. At the same time, global water, energy, and food security trends may be concerning due to increasing competition for sectoral (agricultural, ecosystems, settlements, and industry) water use [1,2]. Water use has risen by around 1% yearly since the 1980s, with no sign of reversing or stabilizing. Globally, 2.3 billion people live in water-stressed countries, of which 733 million live in high and severely water-stressed countries. Additionally, because of global population growth and change in production-consumption patterns, demand for basic natural resources and commodities has substantially risen [3]. International development agencies and the United Nations report project the trends, patterns, and overly concerning statistics on access to potable water and basic sanitation in developing and emerging economies. In most of these settings' human rights related to water availability and quality, food security,

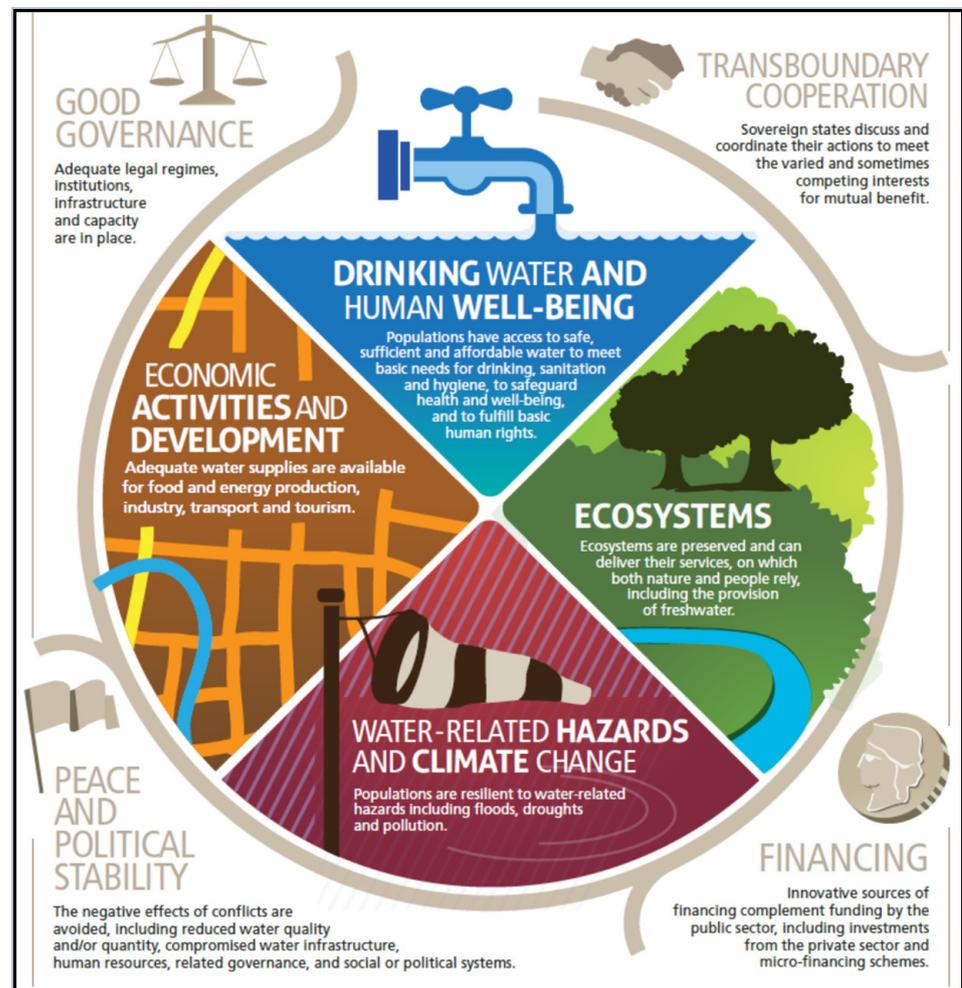
health, and hygiene remain unfulfilled. For instance, in 2020, 2 billion people, nearly a quarter of global population, still lacked access to clean drinking water, and 3.6 billion people (46%) did not have access to proper sanitation [4]. While providing populations and communities with adequate water, energy, and food is universally acknowledged as a global challenge, climate variability and urban warming are emerging as significant global, regional, and local concerns [5]. The impacts of climate change on the water sector are significant and wide-ranging, as the United Nations Environment Program (UNEP) synthesis explains “*the world’s major, the overarching environmental issue today, and the greatest single challenge confronting environmental regulators*” [6]. Such impacts are predicted to be pervasive, catastrophic, and disproportionately dispersed globally [7]. Climate change is also frequently viewed as a key driver of physical and political evolution, geopolitical stability, or conflict [8]. Furthermore, as concerns about the destabilizing effects of climate change grow, it is increasingly being referred to as a security issue [9].

Water security and climate security are intrinsically linked. Climate change is expected to have significant impacts on regional water resources, including groundwater supplies, irrigation, wetlands, streams, riparian ecosystems, and aquatic recreation [2]. Moreover, water scarcity, residential segregation, and access barriers are all increasing due to geopolitical tensions. As of these instances and the increasingly obvious impacts of climate change, water security is a critical aspect of national, regional, and global water governance [10,11]. Overall, unregulated water use, climate change impacts, and inefficient cross-border water-sharing arrangements can collectively cause water crises and other cascading risks. According to forecasts and an emerging body of academic literature, the future water demand is expected to significantly increase, i.e., by about 40% over the existing supply, and states and communities need to prioritize their water security planning [12]. Achieving water security for all remains a key challenge for communities and states as the water and climate crises escalate. In regions where geopolitical volatility and political instability persist, water insecurity cascades into multiple risks [13]. Given this background, this study gives a multi-scalar evaluation at the regional, national, and sub-national scale for MENA and a detailed study of water security concerns and solutions for the West Bank and Gaza Strip. Past, present, and future water and climate security planning initiatives were analyzed. The synthesis presented: (a) key water security dimensions in the MENA region and parts of the West Bank and Gaza Strip, complementing the analysis with a comparative context of the OPT area and the State of Israel; (b) presents the set of challenges, including territorial conflicts on water sharing and water and climate crises manifested at different levels yielding an uncertain water future for the region; (c) outlines narratives to explain how multifaceted complexities influence sustainable water management paradigms, focusing on an incompatible territorial setting between the River Jordan and the Mediterranean, the ongoing volatility and geopolitical tensions between Palestinian territories and the state of Israel, wherein water affairs do not find a spot in peacebuilding options.

### *Concepts and Context*

The Global Water Partnership offered an integrative definition of water security at the Second World Forum in 2000. It examined accessibility, cost, and human and ecological health. Since then, academics and policymakers have interpreted the phrase differently. Others have a multidisciplinary, integrative approach, while others have discipline-based definitions [14]. Where we combine water security with sustainable development in this study, we can consider the following UN Water definition: [15] “*capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability*” and present a conceptual framework that can be adopted from subnational to supranational levels (see Figure 1). The framework encapsulates multifaceted complexities and intersections that water must be capable of supporting health,

livelihoods, socio-economic development, and ecosystems, which is why social, economic, and political factors all play a role in shaping the ability of water to be appropriately provisioned to the populations and communities [16].



**Figure 1.** The UN Water (2013) water security conceptual framework outlines key dimensions that remain crucial to designing and implementing interventions and plans toward water security and climate-resilient communities and regions.

Security in the context of our analysis is not used in a restricted, conventional military sense but rather in terms of human security, which encompasses a range of threats to human well-being, including starvation, poor health, political repression, criminality, and environmental security [17].

In terms of the global water, climate, and disaster governance obligations, we referred to Sendai Framework for Disaster Reduction 2030, Agenda 2030, or Sustainable Development Goals (SDGs), and the Paris Agreement—all of which aim to establish an integrated framework for transitioning to low carbon, water security, and climate resilient economies and societies supported by evidence, research, and integrative planning [18]. SDGs are an internationally agreed upon agenda for development and include a dedicated goal for the water sector (SDG 6) and goals and targets for climate change impacts (SDG 13). SDG 6 was proposed in acknowledgment that access to clean, safely managed water and sanitation are key interventions for primary health prevention and could reduce the global disease burden by 10% [12]. Where this paper discusses transboundary water and cooperation between parties, refer to target 6.5, which asserts, “By 2030, implement integrated water-resources management at all levels, including through transboundary cooperation as

appropriate”, and the related Indicator 6.5.2, “Proportion of transboundary basin area with an operational arrangement for water cooperation” would be helpful to assess the practical implications for countries sharing transboundary waters, particularly among the riparian states of the Jordan Basin (Tri-cluster: Jordan, Israelis, and OPT). (An interrogation of the Sustainable Development Goals (SDGs) and their action towards improving access to water and sanitation was conducted through an analysis of SDG 6, specifically focusing on Target 6.5 and the related Indicator 6.5.2. This study showed that its implementation could have some unintended practical implications for countries sharing transboundary waters. (For more details, see Hussein, Menga, and Greco [19]. Additionally, climate change is regarded by many as a defining challenge of our times, and to that SDG 13 calls for “urgent action to combat climate change and its impacts” [20].

In this context, our synthesis presents a multiscale analysis of options and strategies for planning water and climate security at the regional and national or subnational (regional) levels. The regional scale analysis focuses on the Middle East and North Africa (MENA), comprising 17 countries extending from Morocco in northwest Africa to Iran in Southwest Asia [21]. The water security and climate crisis settings in this region are diverse and include these eight points:

1. Extreme temperature changes, limited groundwater and rainfall, and little arable and cultivable land have made this region a climate hotspot rendering it one of the world’s most susceptible landscapes to climate change [3];
2. The states in the region have 6% of the world’s population but less than 1% of the world’s freshwater resources, making them water-insecure from a hydrological perspective [22];
3. The complexity in water sharing arrangements is inevitable as transboundary water management and cooperation remain a difficult issue in this region, particularly among the three riparian states of the Jordan Basin (Jordan, Israel, and OPT), wherein the regional political situation and geopolitical conflicts have significantly influenced the sharing arrangements to function efficiently [21];
4. Water conflicts are of common occurrence, and the water allocation and distribution mechanisms in this basin are discussed at various regional negotiations and positioned as an important component of the Palestinian-Israeli conflict [23];
5. Water scarcity in Israel and the OPT region has been the subject of much discussion in academics, politics, and the public sphere, both locally and globally [24];
6. Geopolitical tensions pose restrictions on regional water security; for instance, the Israeli-Palestinian conflict is typically presented as a confrontation of equals over a piece of land or access to a resource [22]. The pertinence of this is that the Oslo II water regime unevenly applies to only part of one of the three resources to which Israel and the Palestinians are co-riparians. The utilization of all three resources is highly asymmetrical in Israel’s favor [25];
7. Narratives of water-sharing disharmony in this region are multifaceted; for example, Freij [20] argues that for decades. The day-to-day daily struggles to build stability in the settings of the Palestinian-Israeli conflict, and resulting impacts like displacement, have shadowed attention on sustainability challenges. Moreover, regional water discussions are often dominated by discussions on conflict and challenging circumstances it presents for cooperation towards water management and adaptation strategies [26];
8. Disputes over water distribution from shared aquifers and the Jordan River highlight that cross-border water sharing and collaboration is an unresolved dimension in the regional water governance disclosures [27].

Noting the set of challenges explained above, our synthesis focused on the most challenging settings and critically examined the potential interactions and intersections between water and climate crises and conflict in the region at the national or cross-border level. More specifically, we refer to the following questions:

- (a) What are the key challenges to water security in the region and for OPT?

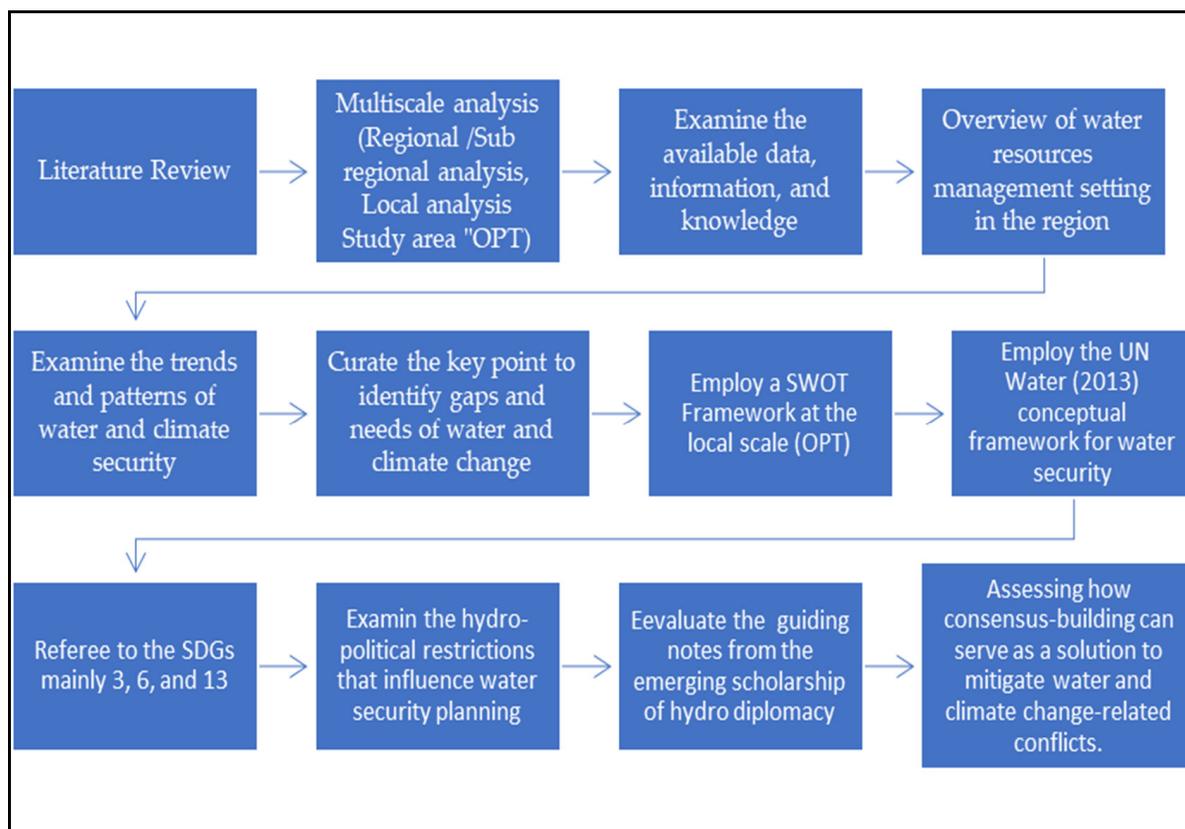
- (b) How does climate change affect water availability and security in the MENA region and OPT?
- (c) What are the barriers and opportunities to water security given the hydro-political conflicts and climate change crises faced by the region and OPT territories?

To examine these questions, this article is organized into three sections. The first section showcases the regional (MENA, part of OPT “West Bank and Gaza Strip”) analysis and complexity associated with water and climate security, wherein territorial conflicts on water sharing and water and climate crises are manifested at different levels. The second section assesses the water and climate security challenges at the sub-regional or basin-scale level focusing on Jordan, Israel, and the OPT and cross-border water management complexities and difficulties in achieving water security. The third section discusses local-scale assessments for the OPT, along with a comparative context with Israel, concentrating on water-related climate change consequences, challenges, and opportunities for climate adaptation strategies. We also outline narratives that explain multilayered complexities influencing sustainable water management paradigms in territorial settings of River Jordan amid ongoing volatility and geopolitical tensions between Palestinian territories and Israel, which influence regional water affairs.

## 2. Materials and Methods

The methodology applied for the analysis included a rigorous literature review and multi-scalar approach, including document and content analysis, taking reference to the set of dimensions (and indicators) of the UN Water [15] water security conceptual framework, water crises aspects intersecting with climate change impacts (Figure 1). The regional (MENA), subregional (Jordan, Israel, and the OPT), and local region OPT (focusing Palestinian-Israeli conflict). For spatial coverage of the OPT, reference to Mapping Palestinian Politics and the European Council on Foreign Relations (ecfr.EU) web interface was used to illustrate that OPT consists of the West Bank (including East Jerusalem) and Gaza Strip and to refer to updated population numbers by the Palestinian Central Bureau of Statistics [28]. As of 2022, close to 5.36 million Palestinians lived in the area (3.19 million in West Bank and 2.17 million in Gaza).

Examining the available data, information, and knowledge, we cast an overview of how water resources management settings in states and regions with complex geopolitical relations operate and how such multifaced complexities, directly and indirectly, impact sustainable water management paradigms since more and more often water is discussed as a subject of conflict in incompatible territorial setting between these parties. To examine the trends and patterns of water and climate security in the region, we curated the key points across different published literature and reports to gain an understanding of gaps and needs. For the local scale analysis, we employed a SWOT (strengths, weaknesses, opportunities, and threats) framework to present the summary of factors that support or undermine the agenda for achieving water security and gather awareness of all aspects involved in decision-making towards planning and policy. In addition, the [15] framework and reference to the SDGs (3, 6, and 13) helped to examine multiple dimensions, including but not limited to the hydro-political restrictions that influence water security planning and climate change adaptation measures. The guiding notes from the emerging scholarship of hydro diplomacy, assessing how consensus building can serve as a potential solution to mitigate water and climate change-related conflicts, were consulted to enrich the discussion and conclusions. The methodological flow chart in Figure 2 illustrates the adopted approach.



**Figure 2.** Summary of methodological pathway applied in this synthesis to assess and analyze the water security and climate change setting at regional, national, and subnational levels.

### 3. Results

#### 3.1. Multiscalar Analysis for Assessing Water Security

##### (a) Regional Assessment for the MENA region

Water stress is a major issue in the region, caused by a combination of precipitation shortage, fast population expansion, and spatial concentration [7]. The population is growing at a pace of 1.7–2% annually, with forecasts indicating a rise from 300 million to over 500 million by 2025 [29]. Due to their geographical location, most MENA countries are characterized by arid conditions, low rainfall (see Annex 1), and high levels of evaporation, leading to limited natural water resources [16]. Several countries report the lowest per capita water availability in global rankings. In addition, low socioeconomic resilience and long history of social and political tensions and geopolitical conflicts, and the ongoing immigration crisis in many states add to the vulnerabilities of people and communities [17]. Water scarcity in MENA’s arid and semi-arid areas has strategic consequences [30], and resulting displeasure with regional administrations is noted. Water and food security indicators in Egypt and Palestine/Gaza are poor, and the demand for water and energy is increasing [3]. This is made worse by the fact that some have better access to clean water than others [31], and equity issues remain unresolved. Water scarcity adds a burden on the region’s capability to manage water resources responsibly and peacefully, leading to misuse, instability, and conflicts [32]. Climate change may worsen water disputes and water sharing, argues Bozorg-Haddad et al., [33] and with continuing armed conflict in Iraq, Libya, Syria, and Yemen—the region is often in the spotlight as a “hotspot” for political, military, and humanitarian conflicts [3,34], these settings often aggravating the resource (land, water, etc.)-related conflicts.

Droughts, heatwaves, wildfires, and other meteorological extremes affect the area [22]. These and other patterns show that the area has been especially challenged in recent

decades because of biogeographical diversity, rapid population increase, considerable social and economic transformations, and armed conflicts in certain nations [35]. Moreover, the Israeli–Arab conflict has global implications, attracting attention well beyond the Israel–Palestine issue. Concerns about the impacts of climate change have often been raised by all parties or states [20]. The negative impacts of restricted freshwater supply are closely tied to agriculture reports [17]. In Table 1, we summarize the key highlights from the analysis, considering the dimensions outlined in [15] and the water security conceptual framework.

**Table 1.** Selected highlights about water security for the MENA region taking note of UN Water’s 2013 water security conceptual framework dimensions.

#	UN Water (2013) Water Security Conceptual Framework Dimensions	Assessment for the MENA Region
1	Ecosystem, Climate Change, and Human Well Being	<ul style="list-style-type: none"> <li>- Summer temperatures may increase by 8 °C, water runoff by 75%, and land aridity by 60% [34]</li> <li>- In the summer, heat waves affect &gt;80% of local communities [36].</li> <li>- About 60 million people lack access to clean water, and over 70 million lack proper sanitation [27].</li> <li>- Climate change has caused severe water shortages (less than 500 m<sup>3</sup>/an/habitant) in Yemen, Jordan, Libya, and Algeria [21].</li> </ul>
3	Transboundary Cooperation	<ul style="list-style-type: none"> <li>- Power imbalance prevents the Jordan River Basin from fairly and evenly sharing water [37].</li> <li>- The power relations in the Joint Water Committee (JWC). The Oslo II Agreement set up the JWC, in which each party has equal representation and veto power, to implement the undertakings under Article 40. According to the agreement, the JWC functions on the basis of consensus; both Israelis and Palestinians must give their approval for any project involving water abstraction from the Mountain Aquifer. Things are not equal where the Israeli representatives have delayed a large proportion of Palestinian applications in the JWC, and the approval rates for Palestinian applications are significantly lower than for Israeli applications [24].</li> <li>- The Euphrates is Syria’s major water supply, whereas the Tigris is Iraq’s. Both are worried about Turkish control of their important rivers [32].</li> </ul>
4	Peace and Political Stability	<ul style="list-style-type: none"> <li>- Around 700 natural catastrophes and 80 inter-state armed conflicts in 18 Mediterranean nations have been noted since 1945 [32].</li> <li>- The Uppsala Conflict Data Programme revealed that natural disasters were likely to precede 50% of conflict outbreaks [33].</li> <li>- The Nile, Euphrates, Tigris, and Jordan rivers have all seen and reported water resource conflicts [38].</li> <li>- In the MENA region, political elites have tackled water shortages by building massive dams, desalination, cross-basin water transfers, tapping into groundwater aquifers, and importing virtual water through food imports [31].</li> </ul>
5	Financing	<ul style="list-style-type: none"> <li>- States in the MENA region have unique political and economic settings [32]</li> <li>- In countries (particularly those in Arabian Peninsula) where natural resources are scarce, inequality is rampant; while some are prosperous economically, others greatly suffer [39]</li> <li>- Water and electricity are scarce and expensive in MENA, compared to other regions [3].</li> <li>- The World Bank is presently investing \$1.5 billion in the MENA region to combat climate change [31].</li> </ul>

(b) Subregional or basin-scale assessment (Jordan, Israel, and OPT)

This section outlines the water-related climate change impacts and adaption strategies, again taking reference to the selected dimensions of the UN [15] water security conceptual framework by picking two key aspects: Transboundary water management and agreements and water-related climate change impacts and adaption strategies.

Transboundary cooperation remains a difficult issue within the Middle East, particularly among the riparian states of the Jordan Basin. Jordan, Israel, and OPT (tri-cluster) are three neighboring countries located at the heart of the MENA—a region with variable degrees of water scarcity [40]. The Jordan River is a transboundary water system shared with the riparian states of Syria, Lebanon, Jordan, Palestine, and Israel. Access and usage of the surface water of the Jordan River are barred for Palestinians according to the terms of Oslo II [41].

The Oslo Accords, signed in 1993, treated water as a quantitative issue, assigning various quantities of water to Israel, the West Bank, and Gaza; however, it did not fully address natural factors and socio-economic developments, thereby creating asymmetric access to precious water resources [42,43].

The Treaty of Peace between Jordan and Israel signed in 1994 has effectively resolved issues that previously contributed to hostility over water resources in the Jordan River because it positioned the agreement as a positive sum gain, required the two countries to find a new water supply, and contained a Joint Water Committee to ensure compliance by both sides [44].

In 1995 the Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip (hereafter referred to as Oslo II) was concluded. (The 1995 Israeli-Palestinian Oslo II Interim Agreement defined four water regimes, which were geographically limited. There are three transboundary Israeli-Palestinian water resources: the Jordan River, on which Lebanon, Syria, and Israel are upstream riparians, while Jordan and the West Bank are downstream; the coastal aquifer, which is mainly in Israel but serves Gaza downstream (Egypt is also a riparian); and the mountain aquifer, in which groundwater flows from the West Bank towards Israel or eastwards into the Dead Sea (again Egypt is also a riparian). Israel is the upstream riparian for two of these transboundary resources (the Jordan River and Coastal Aquifer) (the Mountain Aquifer). In addition to these transboundary resources, Israel has its own aquifers, including the Jordan Valley and Fari'a aquifers (though the existence of these is usually overlooked, thus making it appear that all West Bank aquifers are transboundary and shared; see Selby [25]). As a framework for administrative cooperation in the water sector between Israel and Palestine, the Joint Water Committee (JWC) was organized under the terms of Oslo II (Article 40) [41].

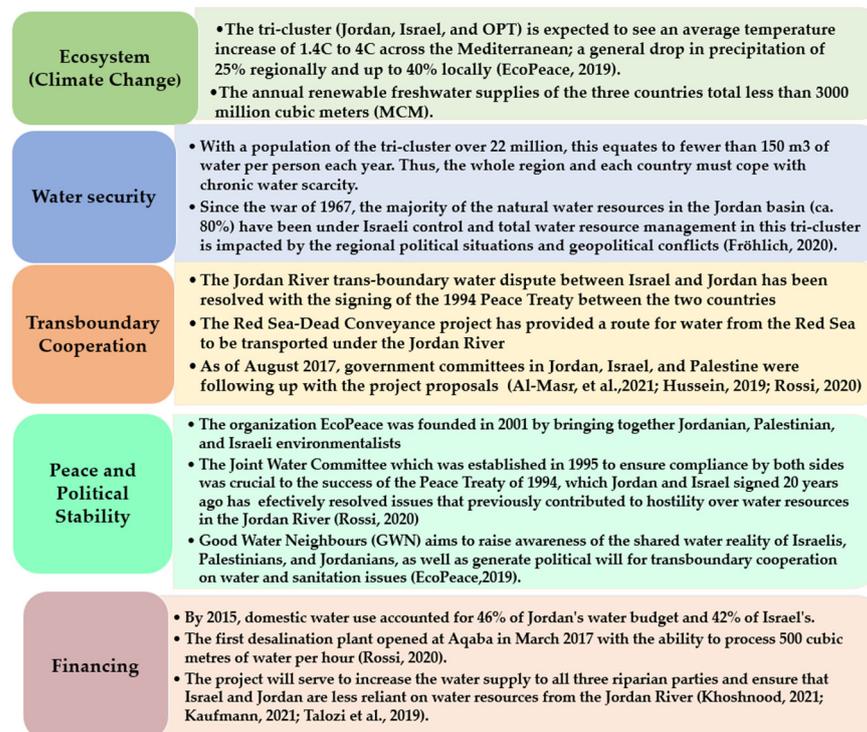
As per the assessment by [27], the river basin is relatively small, and the pressure on the water resource availability is affected by many factors such as climate change, aridity, historical mismanagement of the resources, conflicts, influx of refugees, and an ongoing pandemic, profoundly impact the region, thereby affecting water and food security and the desire of riparian states to be self-sufficient. The Jordan and Israel dispute over water in the Jordan River was settled in a detailed peace treaty in 1994. However, there have long been water conflicts between Israel and Palestine over shared groundwater aquifers and the Jordan river, as well as water distribution arrangements [22]. The unsymmetric water allocation and distribution mechanism in this basin is discussed at various regional negotiations and positioned as an important component of the Palestinian-Israeli conflict [41]. Palestinians' role in the access and use of related arrangements of the surface water of the Jordan River remains insignificant to non-existent.

The Jordan River Basin's climatic conditions have changed, particularly, in terms of rainfall and temperature, with a significant decrease in precipitation in Jordan, Israel, and OPT region, especially during winter—i.e., the months of November, December, and January [44,45]. Based on climate change scholarship from the region, at least three countries (Israel, Palestine, and the western part of Jordan) of the Jordan Valley will struggle to meet existing water commitments and will need to plan sustainable water use strategies to mitigate the looming crisis. While these states have the human capacity and economic capital to mitigate this, a lack of political will to take collective action prevents them from doing so, and climate security is not a top priority for them [46]. As UN Water's [15] conceptual framework notes, transboundary cooperation and climate change impact key dimensions in achieving regional and sub-regional water security; in Figures 3 and 4,

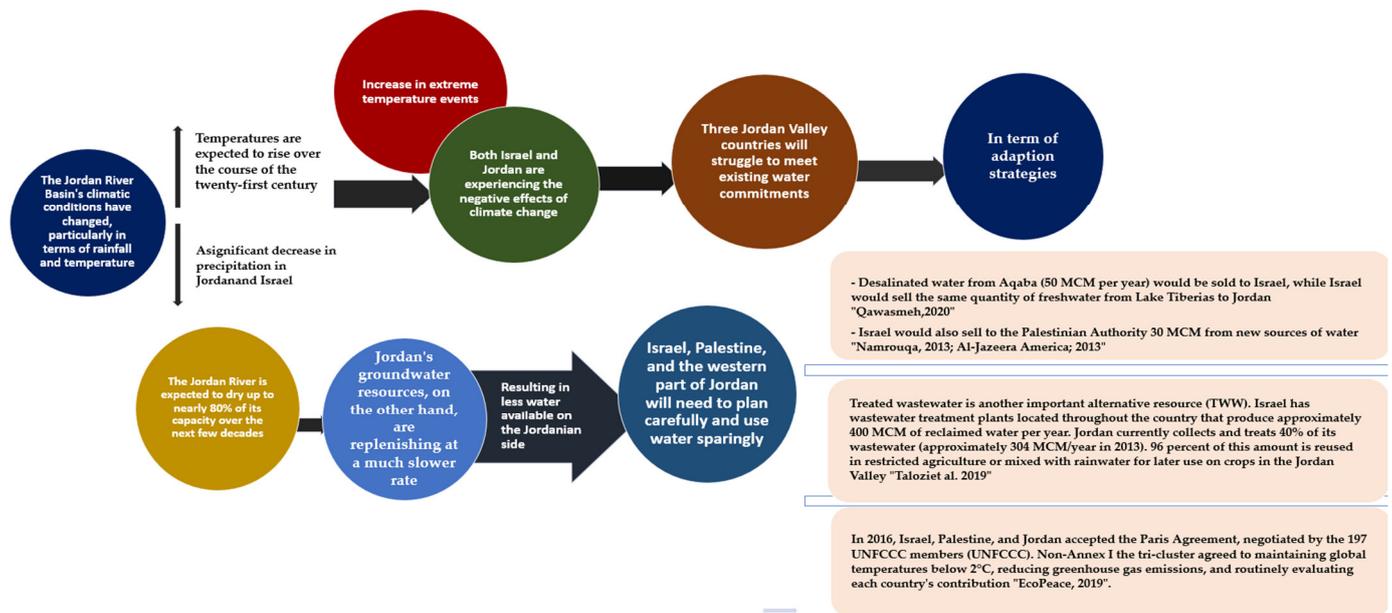
we attempt to deconstruct the interlinkages, challenges, and complexities that operate in selected states.

(c) National-scale assessment

The OPT is in a hot, arid, and water-scarce region where average temperatures over the last fifty years have been rising [47]. These variations place OPT in a “*very vulnerable climatic position*” [20], and its major water supply is groundwater [48]. Most of Israel’s and Palestine’s water comes from the mountain aquifer, the Jordan River Basin, and the coastal aquifer, where the Jordan River Basin feeds water to Israel and Palestine through the Sea of Galilee and the Lower Jordan River [49]. In the West Bank, there are two abundant freshwater sources, both of which are under Israeli control: the Jordan River and three aquifers that are collectively referred to as the mountain aquifer and that extend through the West Bank and Israel [50]; whereas Gaza’s major water supply is the Mediterranean’s southernmost aquifer [29]. In many areas, including the Gaza Strip’s coastal aquifer, water loss exceeds renewable supply [20]. Water scarcity has long frustrated Palestinians in the West Bank and Gaza [38]. In the OPT sub-region, water access and distribution are key issues since the 1967 Israeli-Palestinian conflict. (According to the Oslo I Accord, which dates from 1993, the west bank area was divided into three areas. Area A constitutes 17% of the west bank where Palestinians have administrative and security control. Area B represents 23% of it. In this area, Palestinians have only administrative control, while Israel has security control. Lastly, Area C, which constitutes 60% of WB, is under Israeli administrative and security control. It is worth mentioning that among the 3 million Palestinians who live in the WB, nearly 90% of them live in Areas A and B, while only 10% live in Area C [51].



**Figure 3.** Overview of trends and patterns of selected water security dimensions from the UN Water’s 2013 conceptual framework, with a spotlight on transboundary or cross-water sharing and allocation aspects included (source: created by authors using various data sources) [12,17,22,27,44,45,52,53].



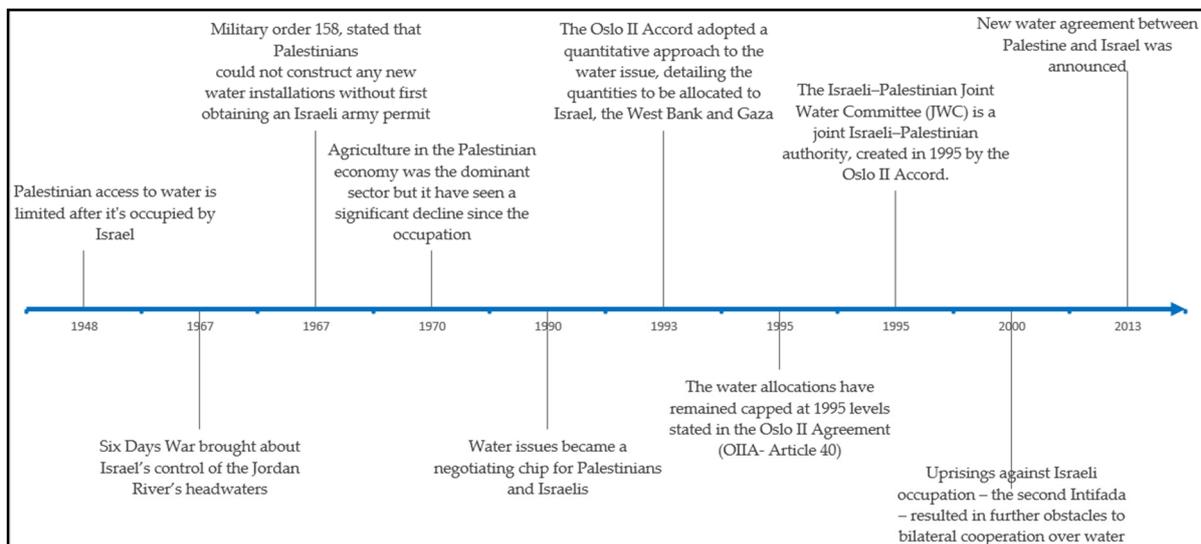
**Figure 4.** Selected aspects related to sub-regional water-related climate change impacts and adaption strategies noted in the region (Jordan River Basin) [17,45,51,54,55].

Projections show that by 2030, Palestinians living in this region may reach 7.2 million. Water consumption is expected to dramatically increase due to population growth and improving economic conditions. The natural population growth rates in the West Bank and Gaza are estimated between 2.6% and 3.5% [56]. As per the UNHCHR [47] the annual supply imbalance in Gaza and the West Bank will be 79 million cubic meters by 2030. In comparison with the Yarmouk and Jordan River surface waters, Palestine’s groundwater supply has progressively dropped [43]. In the other set of statistics, in the Gaza Strip and the West Bank, the average Palestinian uses 88.3 L per day, whereas the average Israeli uses 369.5 L per day per settlement [20,22]. The power differential in all aspects of this cross-border water governance, largely the very different water use trends between Israel and Palestine, has remained a key point of discussion for the regional stakeholders with a vested interest in water affairs and communities. Given the pluralism in transboundary water management, the multi-level water insecurity the region faces, along with geopolitical conflicts, and territorial agendas, including the sovereign state normative, cumulative barriers, restrict discussions on a sustainable future, climate, and water security. Various issues concerning water security are outlined in Figures 1 and 2 and selected points below, taking reference to the UN Water [15] conceptual framework and set of targets from the selected SDGs (SDGs 3, 6, and 13) to examine the multifaceted impacts of water crises and climate change in OPT and the larger subregion.

*Point 1: Understanding water security in the settings of conflicts, and geopolitical volatility*

While examining water security challenges for OPT, it is important to understand this sub-nexus underlined in the water security conceptual framework. Fröhlich’s [22] synthesis that the Israeli-Palestinian water conflict is based on the region’s geographical, climatic, hydro(geo)logical, and demographic realities explain the long-standing dispute with Israel and provides a unique viewpoint to address plural aspects and cascading water risks [43]. Political volatility in the region hinders cross-border water governance discourse coupled with inefficient water management practices rendering OPT and the Palestinians vulnerable to water crisis [57]. Bilateral agreements on transboundary water distribution and control often benefit one state over the other; in this case, Israel [58] is often stated within the concept of water hegemony, dominance, deprivation, politics (hydro-politics), weaponization, etc. and noted as elements of unresolved rights over shared water resources [49].

In the sub-region, Israel has had dominant control of water allocation of the Jordan River and two major regional water sources [43], since 1948 [50] and water infrastructure control after 1967, 6-day war [24,57]. Freij's [20] synthesis reflects on how Palestinians have had limited water access rights to Jordan River water since 1967, which triggered water insecurity in the sub-region (OPT). Moreover, in 1993, the Oslo Accords were signed, treated water as a quantitative issue, assigning various quantities of water to Israel, the West Bank, and Gaza; however, it did not fully address natural factors and socioeconomic developments challenges, thereby creating asymmetric access to precious water resources [46]. It is widely criticized that the accords discourse ignored environmental and social considerations, leaving water disparities [42], economic injustice, inadequate infrastructure, inept water resource management, and disparities stemming from changing trends in water consumption and water access (water rights) between Israel and Palestine [59]. Figure 5 highlights some key events in the water governance history of this region to provide an overview of the past seven decades of dynamics in the shared water resource system.



**Figure 5.** Timeline of Palestinian-Israeli water conflict and agreements. Source: Created by authors, data cited in the text.

*Point 2: Addressing interlinkages between water security and climate change impacts*

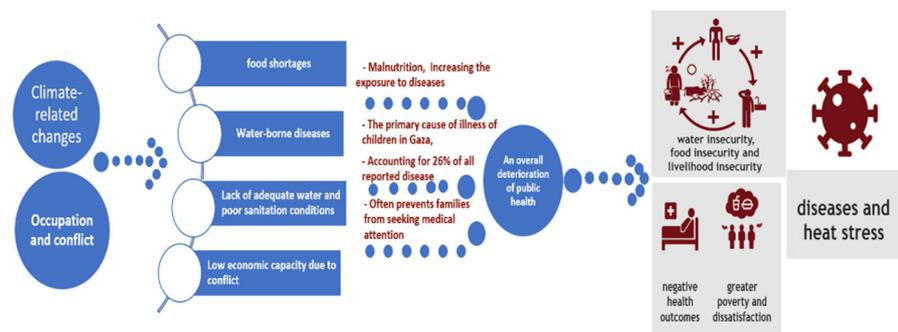
Climate projections in the Palestine region predict a 10–30% decrease in annual rainfall and a 3–5 °C increase in temperature by 2100 [60]. Climate change impacts on groundwater supply are periodically reported, as a key source of water provision for OPT. Its focus on maintaining the recharge of the major aquifers is urgent. Since 1967, Israel shared surface and groundwater with OPT [24]; however, given the set of new challenges faced by communities on water access, joint assessments on regular measurement of groundwater are needed for both states to assess solutions to the water supply-demand gap [56]. Additionally, dry conditions and water crises also relate to soil erosion and desertification which exacerbate the humanitarian and environmental crises in the West Bank and Gaza. In the sub-region, Palestinians also face internal displacement due to the ongoing political crisis, climate change impacts, and political and military interventions directly or indirectly acting as a cause for migration [61]. Future climate change scenarios show that the OPT will face significant warming, decreasing precipitation, and more severe weather; nonetheless, the current political environment of the region is not conducive to holding water security and climate resilience discussions [20,57,62].

*Point 3: Enhancing knowledge on how water and climate crises intersect at the sectoral (agriculture and livelihood) level*

The climatic consequences are anticipated to significantly influence the OPT's agricultural productivity and food supply, causing price instability and food shortages, risking Palestinian lives, and hampering the economic growth prospects. Experts also predict an increase in border conflicts [20] with cascading direct and indirect impacts from extending droughts, modifying livestock and agricultural viability, pests' infestations, illnesses, and exotic species [63]. Depletion of Jordan Valley water resources is attributed to climate change coupled with tensions from settlement expansion and restrictions in Area C [64]. Whereas severe dry conditions and agriculture only contributes up to 3% of GDP in recent years [65]. While agriculture employs only 9% of Palestinians, it generates 20% of Palestine's exports [40]. Furthermore, agriculture is a major producer and consumer of other industries such as food, transportation, and mining [66].

*Point 4: Interlinkages analysis: how water and climate crises impact on Health*

The water and climate crises are impacting people's health in various ways. Added to this, the inability to control disease transmission, extreme weather events that increase illness, and the impact on water, energy, and food production negatively impact health, physical and psychosocial [67]. Climate change may further increase the incidence of water, vector, and food-borne diseases including typhoid fever. In the recent past, the COVID-19 outbreak highlighted national and regional health security risks [68]. Intrascro [69] illustrates how heat stroke and cardiovascular diseases are becoming more common. In Figure 6, we have shown how that occupation, climate change, and water scarcity are connected to health risks in the OPT. Water scarcity caused by climate change and geopolitical hegemony impacts the public health outcomes in the Gaza region, this interlinkage has been sparsely considered or ignored in regional water security and climate resilience building programs. While the continuing armed conflict is wreaking havoc on Gaza's living conditions and leading to the environmental deterioration [70]. For example, military interventions in the region are causing an increase in CO2 emissions due to high-tech equipment and resulting in negative environmental consequences for water, land, and air [71], where the Gaza power plant, which supplies one-third of the Gaza Strip's electrical needs, as well as water pumps and wastewater treatment systems, were damaged during the Israeli military operation [72]. As a result of the destruction of the Gaza Strip's wastewater treatment plants, Palestinians are forced to discharge untreated or partially treated sewage directly into the Mediterranean Sea [73]. The concerns about the health of people and communities in the region are often discussed and disconnected from water planning and policies, although water crises, especially those stemming from water quality challenges, result in a high prevalence of water-borne infections [74]. Water-related infections are the major cause of pediatric morbidity in Gaza and the lack of clean drinking water, poor sanitation, and inadequate sewage treatment pose a high risk of disease outbreaks [47]. Children in Gaza are particularly sensitive to nitrates in drinking water, which stunt growth and harm brain development, according to the UN Special Procedures of the Human Rights Council, also excess nitrates harm pregnant women and increase cancer risk [47].



**Figure 6.** Impact of climate change and occupation on the Palestinians' health (Source: created by Authors, data cited in the text).

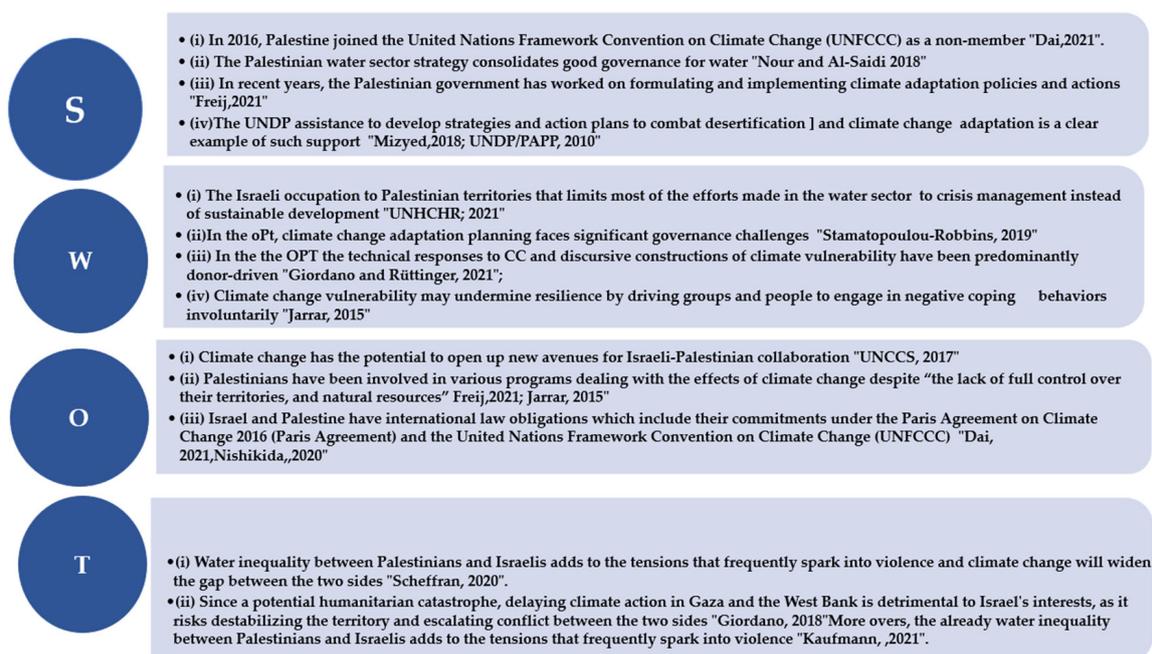
*Point 5: Water security and hydro-political restrictions*

Water scarcity has become a political issue in the region, and as climate change impacts deepen, along with acknowledgment that water scarcity is a technical issue with hydro-political implications [62], it is difficult to evaluate what adaptation solutions can be applied in isolation as water systems are transboundary and water crisis settings are regional as much as they are national and subnational. Palestine is less established but more politicised than Israel, and while climate change poses equal threats to Palestinians in the West Bank and Gaza, as in Israel, it is not their main concern. As Freij [20] states, “*political and economic marginalization*” is exacerbated by climate change and Palestinians are facing increasing pressure to adhere to Israeli legislation, without a collective approach. Environment-friendly options such as renewable energy and desalination plants are impracticable as a long-term solution as of various dimensions of criticism that the sector is subjected to related to brine production. The disposal of brine water is made either directly or indirectly into the sea, sewage system, poor land, channels, wadies, etc. Brine constituents have an adverse impact on the surrounding environment, e.g., sea life, soil, wastewater treatment plants, and the groundwater aquifer. The lack of real environmental impact assessments, especially for mid- and home-scale units may lead to a deterioration of the environment. The Union for the Mediterranean (UfM) is an intergovernmental Euro-Mediterranean organisation brings together all countries of the European Union and 15 countries of the Southern and Eastern Mediterranean Available online: Ufm: <https://ufmsecretariat.org/project/desalination-facility-gaza-strip/> (accessed on 4 October 2022). Based on reviewing different studies and discussions, the researchers summarized the main pillars of the OPT’s water potential and climate change challenges as shown in Figure 7. Dialogue on hydro-political dynamics over shared natural resources remains crucial to resolving a multitude of crises, including the water crisis [27]. Consequently, climate change has a range of consequences for communities and states sharing the water resources, ranging from agricultural productivity and ecosystems to human health and well-being [75], and the impact of current hydro political restrictions is aggravated by scenarios of water scarcity and climate change [76]. Thus, the conflict between Israel and Palestine is linked to the current political scenario, and climate change has been mutually reinforcing for many years, much more so now that no meaningful solution seems to be on the horizon, the old conflict between Israel and Palestine, is now creating new situations of water constraints and conflicts [32,56,76]. Adaptation measures require a focused structure of decisions and behaviors channeled by institutional processes and political norms, at regional, national, and subnational levels, to boost the adaptive capacities of vulnerable communities. Jarrar [62] argues that many adaptation initiatives exacerbate existing gaps and fail to address the core reasons for vulnerability.

*Point 6: Water Security and the SDG 6*

*“To secure water resources and achieve their continuous flow in arid and semi-arid areas of the globe is a highly challenging task because one is dealing with the “management of scarcity” threatened by droughts, climate changes, population growth, water quality deterioration, transboundary water bodies, and social and political detriments” [79].*

SDGs, adopted in 2015, specifically SDG 6, sought to provide universal access to water and sanitation. As the lack of access to water and persisting water challenges in the OPT are well documented. We drew on existing published sources, issuing reports from international agencies viz., UN High Commissioner for Human Rights report, “*The allocation of water resources in the Occupied Palestinian Territory, including East Jerusalem*” [47].



**Figure 7.** Key dimensions in OPT's water crisis and climate change challenges (source: created by authors) [16,18,20,24,27,32,40,41,47,56,62,76–78].

It is worth mentioning that the Palestine Voluntary National Reviews of the 2030 Agenda and its SDGs [80] show a significant decrease in the proportion of the population using safely managed drinking water services, particularly SDG 6.1.1. According to the Palestinian Central Bureau of Statistics (PCBS) Family Survey, approximately 61.9% of the Palestinian population uses safely managed drinking water services, with 90.1% in the West Bank and 13.7% in Gaza. As reported in the PCBS-Palestinian Multiple Indicator Cluster Survey 2019–2020, only 39.5% of the Palestinian population used safely managed drinking water services in 2019, with 66.2% in the West Bank and 4.3% in Gaza [81]. It is worth mentioning that according to the Palestine Voluntary National Reviews to the 2030 Agenda and its Sustainable Development Goals Statistical (SDGs) [82], mainly SDG 6.1.1, indicates a noticeable decrease in the proportion of the population using safely managed drinking water services. (The Palestinian Central Bureau of Statistics (PCBS) is responsible for localizing and monitoring the SDG indicators in cooperation with all relevant ministries and national institutions and in coordination with international organizations, especially UN agencies concerned with these indicators. Source: PVNR [80]. Palestinian National Voluntary Review on The Implementation of the 2030 Agenda; available online: <https://unstats.un.org/capacity-development/UNSD-FCDO/palestine/> accessed on 14 August 2022) The PCBS-Palestinian Family Survey 2010 showed that about 61.9% of Palestinian population used safely managed drinking water services with 90.1% in West Bank and 13.7% in the Gaza Strip. Whereas the PCBS-Palestinian Multiple Indicator Cluster Survey 2019–2020 emphasized that in 2019 only 39.5% of Palestinian population using safely managed drinking water services with 66.2% in the West Bank and 4.3% in the Gaza strip (source: Palestinian Central Bureau of Statistics. Sustainable Development Indicators Database PCBS [81]. Available online: <https://pcbs.gov.ps/SDGs.aspx?pageId=6> accessed on 14 August 2022) [83].

It is widely recognised that achieving SDG 6 for Palestinians needs a political solution including the international scientific community and civil society. Taking note of that need, enhanced understanding of the allocation of water resources and issues challenging equitable access to water and sanitation in the OPT (in the West Bank, including East Jerusalem, and Gaza) including key criteria of availability, quality, accessibility, and affordability remains pertinent and Table 2 summarises these trends and patterns.

**Table 2.** Summary of allocation of water resources in OPT, including East Jerusalem table created by authors using various data sources mainly from UNHCHR [47]. The allocation of water resources in the Occupied Palestinian Territory, including East Jerusalem. Report of the United Nations High Commissioner for Human Rights, Human Rights Council Forty-Eighth session 13 September–1 October 2021, agenda items 2 and 7.

#	Key Criteria	Occupied Palestinian Territories (West Bank and Gaza Strip)	
		West Bank, Including East Jerusalem	Gaza Strip
	Water availability	<ul style="list-style-type: none"> <li>- Nearly 660,000 Palestinians in the West Bank lack access to water.</li> <li>- 420,000 people drinking less than 50 L each day (WHO is below the 100 L recommended)</li> <li>- In Area C, where Israel has full military control, some communities survive on as low as 20 l/c/d.</li> <li>- About 14,000 Palestinians in 180 localities in Area C lack access to water and are in danger of water scarcity.</li> <li>- As of 2014, Israelis consumed 87% of the mountain aquifer waters and just 13% of Palestinians due to Israel's restrictions.</li> <li>- &gt;80% of the West Bank's annual water supply (91 MCM) comes from Meqorot, most of it from the West Bank's Mountain aquifer.</li> <li>- Only 6.8% of the West Bank's farmed area is irrigated due to a lack of water.</li> <li>- Industrial and agricultural sectors are exploiting water resources that should be accessible to people and communities.</li> </ul>	<ul style="list-style-type: none"> <li>- On average, half of the population—or one million people—need water and sanitation interventions.</li> <li>- Gaza's sustainable renewable resources total 90 L per capita per day, yet half is used for agriculture.</li> <li>- Gaza has a chronic electrical shortage, affecting basic services including health, water, and sanitation.</li> <li>- War damages in the WASH sector resulted from the 2014 war. This needs to be revised, because our estimation of the damage reports resulting from this war is around USD35 million (reference, PWA/CMWU damage assessment report).</li> <li>- The Gaza Strip has been under a blockade since 2006, preventing the reconstruction or growth of water-related infrastructure.</li> <li>- The absence of water and sanitation facilities in Gaza has driven people to buy water from private sellers in unsanitary circumstances, putting their health in danger.</li> <li>- An estimated 97% of the population consumes water from unregulated private water tankers and small-scale informal desalination facilities.</li> <li>- In Gaza, 96% of families get water that does not meet the criteria for drinking water.</li> <li>- Water scarcity in Gaza has led to over-extraction of the coastal aquifer, resulting in increased seawater intrusion.</li> <li>- Ongoing conflicts and energy shortages have hampered the operation of roughly 500 vital local water and sanitation facilities, leading to persistent pollution of the coastal aquifer and the surrounding ecosystem.</li> <li>- Water quality is also degraded owing to Israel's delivery mechanism. The Oslo Accords require Israel to give Gaza five MCM annually (The Palestinian Authority purchases water from Meqorot, which streams it through the existing network, where it is then mixed with groundwater, resulting in water that is not fit for human consumption. Although it cannot be used for drinking or cooking, this water is reportedly used for other purposes. In 2019, several reports indicated that work was underway to establish a fourth pipeline that would help double the amount of water supplied by Israel to Gaza [47]).</li> <li>- Intensive use of agricultural pesticides and sewage into the aquifer has resulted in just 12.4% of Gaza wells fulfilling WHO nitrate requirements and 19.3% meeting WHO chloride standards (the State of Environment and Outlook Report for The Occupied Palestinian Territory 2020 [84]. Available online: <a href="https://wedocs.unep.org/20.500.11822/32268">https://wedocs.unep.org/20.500.11822/32268</a> accessed on 7 February 2022).</li> </ul>
	Water Quality	<ul style="list-style-type: none"> <li>- Many Jordan Valley wells have chloride concentrations exceeding the WHO standard (250 mg/L).</li> <li>- Waste from Palestinian cities and villages as well as Israeli settlements pollutes freshwater streams and groundwater.</li> <li>- Wadi al-Nar (Kidron Valley) in southeast Jerusalem is one of the West Bank's most contaminated areas, absorbing about 13 MCM of sewage annually from Jerusalem and Palestinian towns.</li> <li>- Israel sends sewage sludge, infected medical waste, used oils, solvents, metals, electronics, and batteries to the West Bank waste treatment facilities.</li> </ul>	

Table 2. Cont.

#	Key Criteria	Occupied Palestinian Territories (West Bank and Gaza Strip)	
		West Bank, Including East Jerusalem	Gaza Strip
	Water Accessibility	<ul style="list-style-type: none"> <li>- As Israeli settlements expand over the West Bank, including East Jerusalem, land and property have been confiscated, as have natural resources such as water.</li> <li>- Palestinians in East Jerusalem have unique challenges in getting water because of several water systems.</li> <li>- Destroying and confiscating 158 structures in November 2020 (including mobile water tanks, plastic water tanks, and hygiene facilities) and forcing evictions in the Bedouin community of Huma Al-Baqai'a in the northern Jordan Valley of the occupied West Bank resulted in the displacement of 70 people, including 35 children.</li> <li>- Scarcity of safe drinking water in the West Bank, including East Jerusalem, has led Palestinians to purchase water at extremely high prices through official providers and to a lesser extent from private entities.</li> <li>- Cost of purchased water can be six times higher than the national price (USD1.5) per cubic meter in Area C. (The Oslo Accords including the Oslo Interim Agreement (Oslo II signed in 1995), also divided the West Bank into Area A (where the Palestinian Authority would manage full security and civil affairs), Area B (where the Palestinian Authority would manage civil affairs and Israel security control), and Area C (where Israel would have exclusive control). In Areas A and B, Palestinian institutions manage civilian governance, including those relevant to the environment. The Palestinian Authority has no access to Area C (60 percent of the West Bank), which contains the majority of the agricultural lands, water sources, and underground reservoirs of the Occupied Palestinian Territory) [47].</li> <li>- Water costs 15% of household expenditures in Area C.</li> <li>- Approximately 10% of Palestinians in the West Bank buy water from tankers, paying up to 400% more per liter than areas connected to the network.</li> <li>- Water acquired from private tankers may be of varied quality and expensive since it is not regulated by any official body.</li> </ul>	<ul style="list-style-type: none"> <li>- Despite Israel's access to alternative water resources, United Nations Special Procedures mandate holders have highlighted that Israel contributes to the inaccessibility of water in Gaza by using 75 percent of the sustainable groundwater amount each year from the coastal aquifer, leaving little of it available for Gaza.</li> <li>- "Israel has diverted the Stormwater flow from the Jabal Al Khalil mountains towards Wadi Gaza in southern West Bank, which has previously replenished Gaza groundwater".</li> <li>- Gaza's dense population makes accessing water and sanitation facilities difficult.</li> </ul>
	Water Affordability		<ul style="list-style-type: none"> <li>- In Gaza, 64% of the population lives in poverty and drinking water has become costly.</li> <li>- Around 20,200 households cannot afford safe drinking water and depend on public filling stations or poor tap water, putting their children at risk of water-borne illnesses</li> <li>- Affordable water costs should not exceed 3% of family income; however, research shows households in Gaza spend up to a third or even half of their income on water.</li> </ul>

### 3.2. Gaps and Needs for Building Water Security and Climate Resilience

Based on the various aspects of this assessment, selected narratives and relevant aspects toward assessing opportunities and barriers for a framework for integrated agenda in transboundary water context towards options and strategies for planning water and climate security are listed below:

- **Integration of plans and policies to manage water crisis and climate change impacts at national and regional levels.** In this region, states and communities are severely impacted by multifaceted climate change and will unavoidably have to adapt [20]. Adaptation challenges in the OPT involve a spectrum of reactions and particularly managing the diverse impacts of extreme weather events through a multi-stakeholder partnership between governmental, civil society, and commercial sector players [82]. Climate change adaptation often focuses on the national level, on aspects such as internal relocation, and internal displacement as adaptation strategies. However, these options are also limited by political volatility such as the Israeli–Palestinian conflict and the lack of consensus in managing transboundary water, [61]. International agencies like UNDP focus on efforts (projects and interventions) to build a climate change adaptation strategy and action plan with the input and participation of stakeholders [56]. While it is widely acknowledged that integrated agendas to manage water crisis and climate change impacts have the potential to open up new avenues for cross-border (Israeli-Palestinian) collaboration, much is left to explore the full opportunities for collaboration and consent.
- **Adaptation options and solutions to reflect (and address) water-related conflicts.** The region reports on multiple and diverse levels of conflict, including water-related conflicts. Communities and people in the cross-border region are often exposed to military interventions and forced to examine alternative water supply methods, including the use of wastewater for agricultural irrigation and saltwater desalination from the Mediterranean Sea. Some of these alternative methods allow the Gaza Strip’s Palestinian people to have a freshwater supply for their household needs [49]. Critics comment that desalination as an option to fulfill water demand could jeopardize Palestine to negotiate their legitimate water rights in shared water (as discussed: surface water from the Jordan River on the eastern border of historic Palestine and Jordan, and the Tiberias Lake; groundwater from the MAS and its three basins beneath the occupied West Bank and groundwater from the aquifer) systems [24]. There is a constant conflict situation linked to these settings. While it is difficult to envision how considerable improvements in the Gaza Strip’s water supply can occur without massive investment in desalination, and international cooperation [81]. For example, the EU and UNICEF, in collaboration with the PWA and Gaza’s Coastal Municipalities Water Utilities launched a proposal to develop a desalination plant in the Gaza Strip by 2020 [85]. With support from the Kuwaiti Fund via the Islamic Development Bank, the Palestinian Water Authority constructed the first seawater desalination plant in the Gaza Strip in 2019, located in Gaza City and, with a 10,000 cubic meters daily capacity to service about 200,000 people (i.e., 10% of the OPT population in Gaza strip) [46]. In March 2018, a financial commitment of about EURO456 million to the Gaza Central Desalination Plant and Associated Works Project committed to producing 55 MCM of water supply all year long, with energy supply from solar facilities [40,86]. In the context of leveraging alternative means for adaptation, [46] commented that enhanced solar capacity could thrive in Gaza and help fill the energy demand; however, land rights are a barrier. In Gaza, three desalination plants supported by the international community produced approximately 13 million cubic meters of water annually. It is also acknowledged that the process requires significant amounts of electricity and fuel; as a result, acute power shortages and restrictions on material imports limit their ability to operate at full capacity or to ensure adequate and continuous access to water which remains a critical challenge [47]. Israel’s control, particularly in Area C, significantly restricts the spectrum of activities that Palestinian policymakers may independently undertake toward the sense of water security for citizens and communities. The permission of the Israeli Civil Administration is required for the bulk of water and energy infrastructure projects in the West Bank [87].
- **Multilevel strategies for planning water and climate security.** The water and climate security agenda must be evaluated within a political-economic framework, and

solutions challenges for specific challenges in a region or community are appropriately assessed and addressed [20], it is widely acknowledged that governance challenges operate at the local scale. For instance, in the OPT lack of capacity of national agencies and local governments to develop effective adaptation and DRM plans; or lack of mechanisms to enable suitable planning and implementation, or it can be limited information on technological options to address the challenges [76]. Overall, the political environment affects the authorities and institutions' capacity to actively respond to emerging water crisis or insecurity scenarios or to deploy context-specific water and climate security strategies [26]. In this context, the UNDP lead strategy identified adaptation options for the OPT and recommended 'no-regrets' and 'low-regrets' adaptation measures that position water as the priority focus in managing climate change impacts should be attended to on a priority basis. Further, noting that the Jordan Valley and the Gaza Strip experience a high level of climate vulnerability, in tandem with increasing water and food insecurity concerns, this strategy should acknowledge agriculture as the most sensitive sector of the Palestinian economy, and in the face of future climate risks the 'need for climate modeling and research capacity-building in the OPT' is tailored to local and subnational adaptation priorities [62,78,88]. It is crucial to note that at the national level commitments, both Israel and Palestine have international law obligations which include their commitments under the Paris Agreement on Climate Change 2016 and the United Nations Framework Convention on Climate Change (UNFCCC) adopted by both parties [24,40,41] in which, Palestine upgraded its status (17 March 2016) from "Observer" to "Party" to the UNFCCC to becoming its full member [89].

### 3.3. Key Discussion Points

The complexities in managing shared water systems can deepen if water crises are exacerbated by climate change trends, in particular shifting precipitation trends or low precipitation cascading to dry conditions or droughts, as is noted for Palestine. Therefore, the need for a systemic and standardized approach to water security at the national and regional levels remains a gap. We propose UN Water's [15] water security conceptual framework as a platform for the states and region to organize short-, medium-, and long-term goals toward achieving the water security vision, by creating strategic plans and policies that are reflective of contemporary water challenges in multiple sectors viz. agriculture, industry, sharing norms across borders, governance, etc. Such planning needs to acknowledge and include governance challenges such as (a) a general lack of capacity for national agencies and local governments to develop effective adaptation and disaster risk management strategies; (b) limited tools and systems to facilitate appropriate planning and implementation of climate change adaptation; and (c) deficiency of information on technological adaptation and sustainable development options [20,76].

Given the above stated context, we have outlined ten key points that can guide policy, planning, investment, and financing of the water sector in Palestine and in the region where the state has shared water systems.

The increasing pressure from water scarcity due to population growth and increasing economic development activities, limitations in capacity and access issues to mountain aquifers, and shared surface water are gradually breeding water insecurity and water conflicts in Palestine and the border regions.

At the regional scale, water conflict prevention needs the states in the Jordan River Basin (in particular, Israel and Palestine) to reach an agreeable and inclusive water allocation and management agreements and arrangements that are in line with the contemporary water and climate crisis scenarios.

Hydro-political tensions limit the constructive dialogue between water-sharing states, thereby acutely inhibiting consensus building toward a common water security agenda. The deepening water crisis, in particular, the lack of access to clean drinking water continues to impact millions living in Palestine, and water conflicts are not uncommon amid the

lack of water policy reforms (including cross-border water sharing arrangements) that can support conflict mitigation.

Arrangements like the Oslo II Interim Agreement reflect the need to better manage shared waters. However, experts reiterate that political volatility in the region hinders cooperation, and the acknowledgment of the water rights of different stakeholders, thus, preventing transboundary water governance from being an equitable and operational measure to mitigate conflicts related to water.

In Palestine, significant uncertainties about the multidimensional impacts of climate change, territorial disputes, and degradation of natural resources are reported, and development programs addressing capacity needs for tackling climate change are deployed at a national scale, for instance, the UNDP Program of Assistance to the Palestinian People [78], wherein the Palestinian Environmental Quality Authority was involved.

Promoting the development of alternative water provisioning solutions like desalination offers a timely solution to fulfill the growing water demand in various sectors; however, looking forward, it is difficult to assess how considerable improvement in the water supply can occur without an inclusive regional water security planning.

Regional water security discussions and strategies should aim to enhance integrated approaches to plan, i.e., surface and subsurface water crises as well as addressing barriers and outline 'context specific' coping strategies, and refine and reform transboundary arrangements to reflect the challenges faced by communities and people, and deploy research and funding for better understanding of interlinkages in water quality, availability, and distribution of surface and subsurface water resources.

Addressing intersectional challenges in resource (water) management will require multi-agency collaboration to monitor and address resource degradation activities such as over-extraction from aquifers, contamination of subsurface water from sewage, saltwater intrusion, and how climate change impacts the overall hydrological cycle and cascading risks like negative health outcomes from water quality.

Boosting hydro-diplomacy for the better facilitation of cross-border water management is a key point highlighted in this synthesis. This could also mean strengthening multi-stakeholder cooperation and collaboration in assessing how various local and cross-border water-related challenges manifest and how climate change influences conflicts, the water rights of people, and the territories.

The water security conceptual framework is reflected as an option to outline sectoral pathways (economic activities dependent on water, water service delivery as a social contract including drinking water and sanitation needs. etc.) to mitigate the water crisis in Palestine. It is anticipated that the water security framework can also facilitate the integration of human rights to water in water governance planning and shaping a collective approach for climate resilience; installation of a monitoring tool for assessing the various water consumption trends from the shared water resources (surface, subsurface and underground) and to secure fair distribution and utilization of the shared water resources among the riparian states.

### *3.4. Concluding Notes*

We reiterate that the escalating water and climate crises will deepen, and at the national and local scale for Palestine, the restrictions and geopolitical tensions about shared waters can render coping and adaptation mechanisms for people and stakeholders challenging. Noting how the overall political environment affects the regional and national authorities and related governance system's capacity to respond to expected climate change and its influence on regional water supply [26], this assessment presents gaps and needs to support stakeholders and planners to use as a reference in progressing the discussions on water security and climate resilience. Overall, this synthesis illustrates how climate and water crises are linked to resource conflicts and what barriers and opportunities to mitigate water insecurity exist in the complex cross-border region where water and the multiple impacts of hydro-political limitations inhibit inclusive and fair arrangements for sharing water

resources and reiterate the need for a collective agenda. The assessment also echoes the necessity to boost collaborative mechanisms toward defining and designing (proposing the UN-Water [15] water security framework as a guiding tool) collective actions toward water conflict prevention and a vision of water security for all.

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