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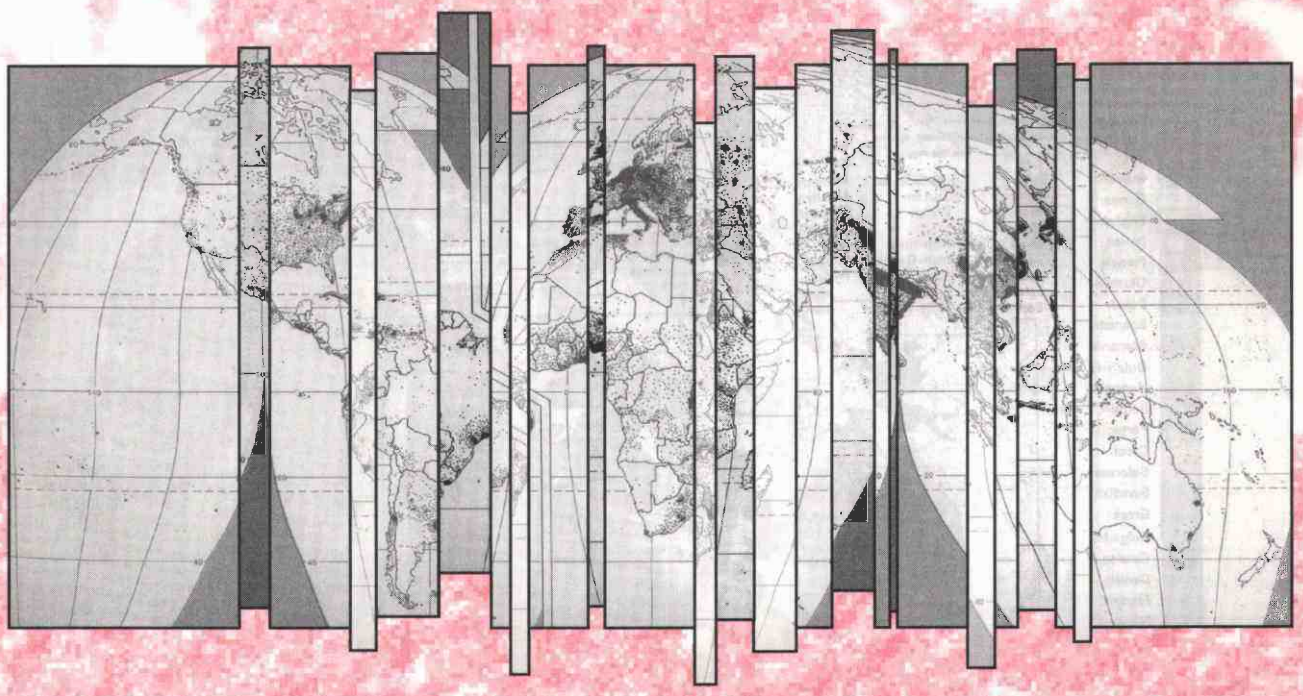
Environmental Scarcity and Violent Conflict: The Case of Gaza

Kimberley Kelly and Thomas Homer-Dixon



American Association for the Advancement of Science

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To obtain additional copies, briefing schedules and Project information, contact:

Brian D. Smith
Project Coordinator
Population and Sustainable Development Project
American Association for the Advancement of Science
1333 H Street, NW
Washington, DC 20005

Voice: (202) 326-6652
FAX: (202) 371-0970
Internet: BSMITH@AAAS.ORG

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Foreword

Project Overview

The Project on Environment, Population and Security is an activity of the Peace and Conflict Studies Program of the University of Toronto conducted in cooperation with the Population and Sustainable Development Project of the American Association for the Advancement of Science in Washington and the Canadian Centre for Global Security in Ottawa. The project began in July 1994 and is supported by the Global Stewardship Initiative of the Pew Charitable Trusts.

The project will gather, evaluate, integrate and disseminate existing data on causal linkages among population growth, renewable resource scarcities, migration and violent conflict. This effort will be guided by three key questions:

- What is known about the links among population growth, renewable resource scarcities, migration and violent conflict?
- What can be known about these links?
- What are the critical methodological issues affecting research on these links?

To date, the policymaking community has not had adequate access to the best research findings on the linkages among environment, population and security. The evidence is in disparate form, often scientific in nature and not easily comprehended by those outside specialist audiences. Therefore, this project will gather as much evidence about such linkages as possible; examine and compare the best material to see if common patterns of causation exist across societies, economic regions, and time; and provide accessible summaries of these findings to policymakers.

The information and analyses generated by the project will:

- help policymakers better understand where to intervene to improve social outcomes;
- strengthen the research methodology and theories that could help scholars and policymakers understand common patterns of causation across diverse societies;
- gather together a large quantity of relevant data and make these data available to researchers and policymakers; and
- strengthen the network of experts, opinion leaders and policymakers interested in these issues.

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Kimberley Kelly

Thomas Homer-Dixon

January, 1996

Summary

The achievement of limited autonomy for Palestinians in Gaza and Jericho in 1993 engendered hope for peace in the Middle East, yet violence persists. The links between environmental scarcity and conflict are complex, but in Gaza, water scarcity has clearly aggravated socioeconomic conditions. These conditions, in turn, have contributed to the grievances behind ongoing violence against Israel and emerging tensions among Palestinians in Gaza.

As the first source of freshwater north of the Sinai Desert, the area currently known as the Gaza Strip was once considered to have great strategic value. However, a massive influx of refugees to the area in 1948 placed tremendous stress on its fragile resources. By the time of Israeli occupation in 1967, Gaza hovered on the verge of a water supply crisis. Today, sapped by further years of strain on limited resources, Gaza has become "the most horrifying case of all"[1] in the notoriously water-scarce Middle East region. Rapid decline in both the quality and the quantity of water supplies, frequent outbreaks of waterborne disease, increased alkalinity and salinity of the soil, and the almost total absence of proper sewage disposal or reasonable domestic hygiene have made Gaza "an area which even the most fervent Zionists recognize as a drain on the state that should be off-loaded [to] any Arab country willing to accept it."[2]

In August of 1993, Israel did indeed "off-load" Gaza, ceding partial power to a Palestinian administration. Amid much ceremony on the White House lawn, Israeli prime minister Yitzhak Rabin and Palestine Liberation Organization (PLO) chairman Yasir Arafat shared a reluctant handshake as U.S. president Bill Clinton bid them "shalom, salaam, peace." However, the transition to Palestinian self-government in Gaza has proved anything but peaceful. As of mid-1995, Israeli security forces continued to clash with Palestinians on the edges of the autonomous areas; within Gaza, confrontations between the new Palestinian administration and its Islamic opposition have sometimes turned violent; and Islamic militants

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have launched suicide bomb attacks against Israeli targets in an attempt to derail the peace talks. In the two years since the "Gaza-Jericho first" accord, hundreds have been killed in continuing violence.[3]

The Western media usually explain this conflict as a result of the spread of fanatical Islamic fundamentalism in the Territories. Yet this focus often distorts rather than clarifies the roots of violence, by giving insufficient consideration to underlying political, economic, and ecological conditions.

In the case of Gaza, years of occupation and resistance have interacted with severe resource scarcities to produce a dismal socioeconomic environment, which has raised the probability of seemingly "irrational" violence. Where opportunities for peaceful expression of deep grievances appear inadequate and living conditions are desperately poor, violent self-sacrifice may take on its own peculiar logic. As Mustafa al-Masri, a psychiatrist at Gaza's only community mental health program, says: "In the hopelessness and helplessness of this world, there is the bright promise of the next life."[4]

While the links between environmental scarcity and conflict in Gaza are complex, it is clear that over the years water scarcity has worsened socioeconomic conditions. These conditions, in turn, have contributed to the grievances behind ongoing violence against Israel and tensions among Palestinians in Gaza. To describe this relationship, we provide an overview of Gaza's recent political history and then analyze the current state of water scarcity and its impact on economic and political stability.

We must note, however, that our analysis has been hindered by a critical shortage of good data.[5] Any information on water is politically sensitive. No figure on population, water supply, or consumption stands uncontested. The situation is further complicated by the fact that resources and population in Gaza are administered by several authorities, including the UN Relief Works Agency (UNRWA), the Israeli military government, and the Palestinian Authority (PA). The PA took over the administration of Gaza's agricultural water supply in May 1994. The Gaza Agricultural Department, while staffed with experienced Palestinian water professionals, had been deprived of resources, staff, equipment, and training throughout the occupation.[6] The lack of sufficient institutions for water management under the PA further limits the availability of accurate data. Despite data problems, however, few deny that the water situation in Gaza is now desperate.

AUTONOMY: TOO LITTLE, TOO LATE?

From 1917 to 1948, Gaza was a part of Palestine under the British mandate. The current boundaries of the Gaza Strip are a product of the Arab-Israeli War of 1948, which incorporated two-thirds of mandate Gaza into Israel. An armistice between Israel and Egypt brought the remaining one-third of Gaza's most marginal land — the 365 square kilometers now referred to as the Gaza Strip — under Egyptian military administration. The 1948 war displaced approximately 900,000 Palestinians; 250,000 of these refugees fled to the Gaza Strip, increasing the population of the area by more than 300 percent. The huge influx, combined with the loss of resources and disruption of domestic trade, created a unstable economic situation. The Egyptian administration did little to promote economic self-sufficiency in Gaza or to increase ties with its own economy, assuming instead that Gaza's future would rest on an economic relationship with Israel. By the time of the Israeli occupation of 1967, Gaza's economy remained "fragile and underdeveloped," dominated by its service sector, and heavily dependent on citrus agriculture.[7]

The Six-Day War in June 1967 brought both the West Bank and the Gaza Strip under Israeli occupation. Israel fostered economic dependence in order to keep a hostile Palestinian state from being established on its vulnerable borders. Israeli policy exhibited two overriding priorities: absolute control over land and water resources in the Occupied Territories and suppression of any form of

independent political or economic organization.[8] In Gaza, these aims were embodied in a range of discriminatory policies, including the expropriation of land and water resources, restrictions on research and training, low levels of investment in infrastructure, the absence of financial support or credit facilities for Palestinians, the prohibition of land- and water-use planning, severe restrictions on travel, and restrictions on exports.[9] A large percentage of the Gaza workforce became incorporated into the lower echelons of Israel's economy, especially in construction and as unskilled labor. The net effects of these policies have been the economic and political isolation of the Palestinian population in Gaza and the further weakening of already fragile local economic structures.[10]

From the outset, the occupation was resisted within both the Occupied Territories and throughout the Palestinian diaspora. Internationally, it brought the PLO to prominence. Formed in 1964 by a summit of Arab leaders, the PLO served as an umbrella organization for various groups supporting the cause of disenfranchised and displaced Palestinians. In the early years of the occupation, the PLO became notorious for airplane hijackings and attacks on Israeli civilians. Although these activities did much to undermine the international legitimacy of the PLO, they did not extinguish concern for Palestinian rights. In 1974, the United Nations (UN) granted the PLO observer status as "the sole legitimate representative of the Palestinian people." The PLO has undeniably served as a locus of unity for Palestinian nationalism. However, its history is primarily that of a representative body in exile — a symbol of struggle with little hand in the day-to-day lives of Palestinians in the Territories. This gap between the powerful symbolism of the PLO and its efficacy in the Territories was thrown into sharp relief by the outbreak of the *intifadah* in late 1987.

The intifadah caught Israel, the world, and the PLO by surprise. A sustained and largely grassroots uprising that began in Gaza's Jabalya refugee camp (which residents now refer to as the "camp of the revolution"), the intifadah was the culmination of years of sporadic resistance. On 8 December 1987, funeral services for four Palestinians killed by an Israeli army tank transport became a massive rally of ten thousand protesters. Within days, similar protests erupted throughout Gaza and the West Bank. The Israeli government immediately took military action to suppress what it dismissed as "riots." Anita Vitullo, an observer in Gaza at the time, noted, however, that the protests exhibited a "sense of community, purposeful resistance."[11] The acts of civil disobedience that characterized the intifadah were not in themselves significantly different from those preceding them. What differentiated the intifadah was its duration and its scope. Prior resistance had been commonplace, yet widely dispersed and therefore containable; the intifadah, despite its spontaneous origins, rapidly became organized, widespread, and sustained, rendering the Occupied Territories largely ungovernable.[12]

The uprising drew massive media coverage and shifted international attention from Palestinian terrorism to the nature of the Israeli occupation. It put a face on the people whom the PLO ostensibly represented, which increased the organization's international legitimacy,[13] but it did so at a considerable cost. It also resulted in large loss of life, declining living conditions, and intra-Palestinian violence, including the killings of suspected collaborators. Israel's imposition of prolonged curfews and closures of the Territories in response to the uprising cut off Palestinians from their livelihoods.[14]

The Persian Gulf War brought an already precarious situation to the point of total collapse. As a result of the Iraqi occupation of Kuwait and PLO support for Iraq, remittances from Palestinians employed in the Persian Gulf states fell sharply. Moreover, direct aid to the PLO from Saudi Arabia was cut off and transfer payments to the Territories from the PLO declined precipitously. Palestinian employment in Israel fell to its lowest level since the occupation of the West Bank and Gaza in 1967. Gaza was also cut off from its principal export markets in the Persian Gulf, resulting in a crisis for citrus agriculture.

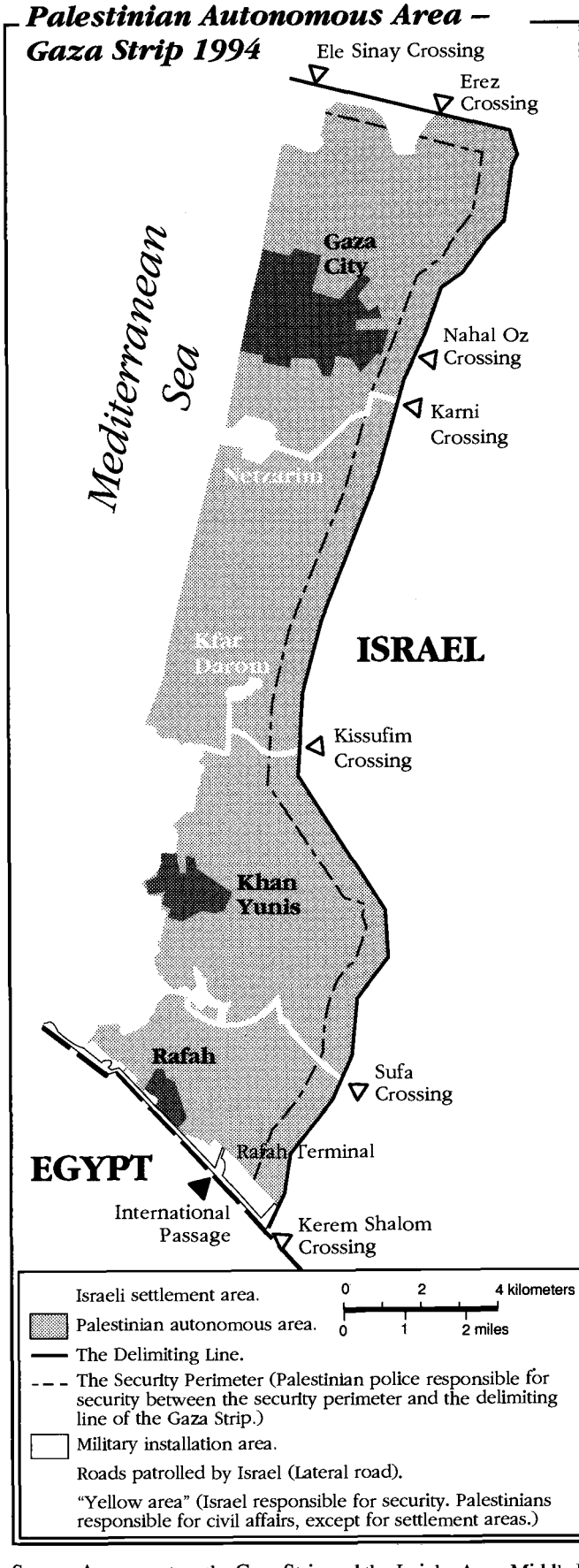
Violence in the Territories rose as conditions deteriorated. In March 1993, Yitzhak Rabin's newly elected Labour government responded by sealing off the Territories, cutting off 130,000 Palestinians from their jobs in Israel. Israel eventually allowed a small percentage of workers back into Israel and promoted some local job creation within Gaza.

However, the number of unemployed far outstripped Gaza's capacity to absorb labor into its devastated economy.[15]

As conditions in Gaza deteriorated, Arafat attempted to shore up his eroding position by renouncing violence and calling for an end to the uprising. Eventually, secret talks culminated in mutual recognition by Rabin's government and the PLO. This recognition, in turn, set the stage for the signing of the Gaza-Jericho First Accord (the Accord) that provided limited autonomy for Gaza Palestinians. The signing ceremony sparked celebrations among Israelis and Palestinians who hoped that the agreement would be the beginning of a lasting peace in the region, but the stability of a semiautonomous Gaza was almost immediately in jeopardy. By the time the agreement was signed, the economic crisis had fractured the once-strong nationalist unity in Gaza, and "growing inter- and intra-factional rivalries for...scarce resources were increasingly apparent."[16]

The Accord has transferred responsibility for a resource-poor, overpopulated, and politically unstable region — a region frequently referred to under Israeli occupation as a time bomb — from Israel to the newly formed PA. The future of the peace process has been made conditional on the authority's success in creating a stable political entity in Gaza, and yet the limited autonomy under which this is to be achieved has proven to be more restricted than many had anticipated.

Because of its size and position between Israel and the Sinai Desert, the Gaza Strip can be easily sealed off and isolated. Outside and on the edges of the autonomous area, many policies of occupation have continued unabated.[17] Freedom of movement for Palestinians has actually been reduced; travel between Gaza and the West Bank is all but impossible. Within Gaza, Israeli troop levels have not declined. The Israeli military remains in control of all main roads[18] and of the areas around the Jewish settlements, which, while small, are dispersed throughout Gaza.[19] Overall, the Israeli military still controls over one-third of Gaza's territory.



Source: Agreement on the Gaza Strip and the Jericho Area. Middle East Report 25. No. 314 (May-June/July-August 1995), p.30. Reprinted with permission.

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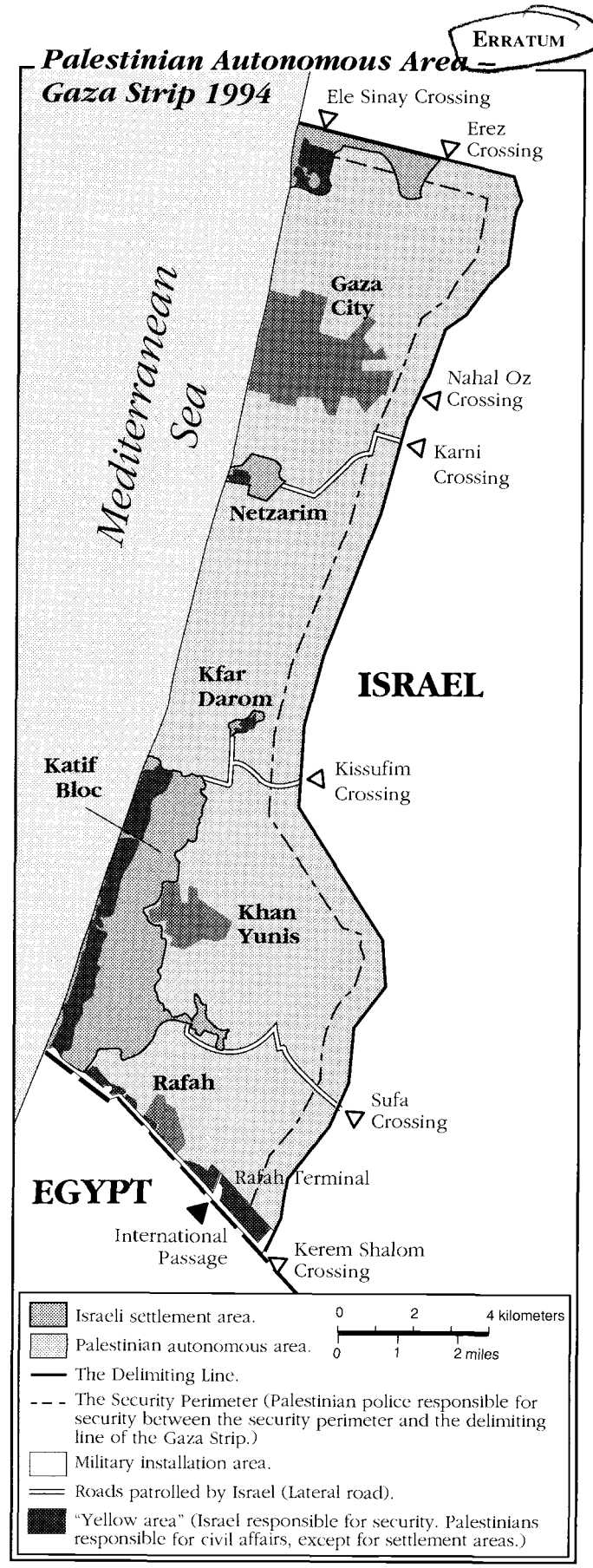


Source: Agreement on the Gaza Strip and the Jericho Area. Middle East Report 25. No. 314 (May-June/July-August 1995), p.30. Reprinted with permission.

Within the autonomous areas, the optimism engendered by Arafat in July 1994 gave way to a more cautious view of the future. The political freedom thought to have been promised by the agreement failed to quickly materialize and some of Arafat's actions have been perceived as autocratic and biased. He has kept his PLO patronage network firmly in place, installing formerly exiled old-guard Fatah officials in positions of power, at the expense of Gaza's younger activists. These actions have cost the PA the substantial grassroots support enjoyed by the local Fatah activists, who are seen as having paid their dues by organizing within Gaza under the pressures and dangers of the occupation, and who often served jail terms for their activities. Furthermore, many of Arafat's appointees "lack credibility or legitimacy within the community [and] are distrusted or hated, and, in some instances, even perceived as collaborators."[20] The conspicuous consumption of many appointees in the face of Gaza's extreme poverty has further undermined the image of the new administration.

The most significant issue for the majority of Gazans is whether or not the PA can improve economic conditions. Since the implementation of limited autonomy, there have been visible signs of improvement — wealthy returnees have financed a construction boom. Nonetheless, unemployment has risen, and the grim living conditions of most Palestinians have not markedly improved.[21] The PA has come under fire for relying on its police force to maintain control.[22] Arafat himself has staked his position on the success of the peace process, yet since negotiations began, support for the process among Palestinians has fluctuated greatly, both within the Territories and in the diaspora. While most Palestinians remain supportive of Arafat, opponents of the process have been vocal: Arafat has on occasion been accused of losing sight of the goals of Palestinian nationalism, ignoring the Territories for which he is now responsible, trading away the gains of the intifadah, and tying himself to an Israeli agenda.

At first, disenchantment with the PA within Gaza was accompanied by vocal support for Islamist groups, such as Hamas and Islamic Jihad.[23] In November of 1994, thousands protested at the funeral of an assassinated Islamic Jihad leader, and Arafat was roughed up by protesters and forced to leave the ceremony. The media described the protest as a reaction to declining conditions, the slow pace of reform, and Arafat's "hounding" of Islamic leaders in the Territories.[24] While Hamas's leaders immediately issued an apology and called for unity, the incident illustrated increasing intra-Palestinian tensions within Gaza.

Initially, Arafat responded by adopting increasingly authoritarian measures, requiring that permits be issued for public gatherings and delaying the distribution of newspapers that allegedly exaggerated the number of people involved in pro-Hamas demonstrations. Numerous petitions for Arafat to reform his methods and increase his accountability to his constituents have had little effect. Shortly after the Accord was signed Edward Said wrote that "the leadership has so misunderstood its people that there is now simmering — and frequently open — revolt more or less everywhere that Palestinians gather and live."[25]

Since then, however, Palestinian support for Islamic radicals has fallen. Every time a bomb explodes in Israel — and Israel responds by closing its borders to Palestinian workers and trade — there is a popular reaction against Hamas and Islamic Jihad within Gaza. The result of Palestinian disillusionment with both the PLO and the Islamists has been rising political apathy and disengagement.

ENVIRONMENTAL SCARCITY AND VIOLENT CONFLICT: A THEORETICAL OVERVIEW

The environmental effects of human activity are a product of the total population in a region and that population's per capita physical activity. The vulnerability of the local ecosystem to this activity is also important. Both a higher population level and more intensive per capita activity lead to greater stress on the environment. The degradation of agricultural land, forests, water, and fish stocks are the critical environmental effects that contribute most to social turmoil.[26] But it is important to note that it is not only degradation and depletion of these renewable resources — that is, reductions of total resource quality and supply — that causes turmoil. Rather, analysts should focus on the overall *scarcity* of resources.

There are three forms of "environmental scarcity." *Demand-induced* scarcity is caused by population growth or increased per capita activity; the resource must be divided among more people, or more intensive activity increases demand for its use. *Supply-induced* scarcity occurs with a drop in renewable resource supply because the resource is degraded or depleted faster than it is replenished. *Structural* scarcity arises from an inequitable distribution of resources — they become concentrated in the hands of a few people while the remaining population suffers resource shortages.

These three types of scarcity often occur simultaneously and interact.[27] Two patterns of interaction are common: resource capture and ecological marginalization. Resource capture occurs when demand- and supply-induced scarcities interact to produce structural scarcity: anticipating future resource shortages, powerful groups within society shift resource distribution in their favor, subjecting the remaining population to scarcity. Ecological marginalization occurs when demand-induced and structural scarcities interact to produce supply-induced scarcity: marginal populations are often forced to migrate from regions where resources are scarce to regions that are ecologically fragile and extremely vulnerable to degradation.[28]

The links between environmental scarcity and conflict are neither inevitable nor deterministic. There are many possible "contextual" variables — from relations among ethnic groups and classes to national culture and prevailing market mechanisms — that affect the strength and kind of relationship between resource stress and violence. However, if these contextual factors prevent a society from effectively adapting to resource stress, four kinds of social effects are likely: decreased agricultural production, regional economic decline, population displacement, and disruption of legitimized and authoritative institutions and social relations.[29] These effects, either singly or in combination, can in turn produce or exacerbate conflict that is generally "persistent, diffuse and sub-national."[30]

THEORETICAL APPLICATION: WATER SCARCITY IN THE GAZA STRIP

Sandra Postel calls the Middle East the "region of the most concentrated water scarcity in the world," with nine out of fourteen countries facing water-scarce conditions.[31] In Gaza, the water crisis is a function of population growth, an agriculturally intensive economy, a fragile water ecosystem, and a highly inequitable distribution of resources (See Figure 1).

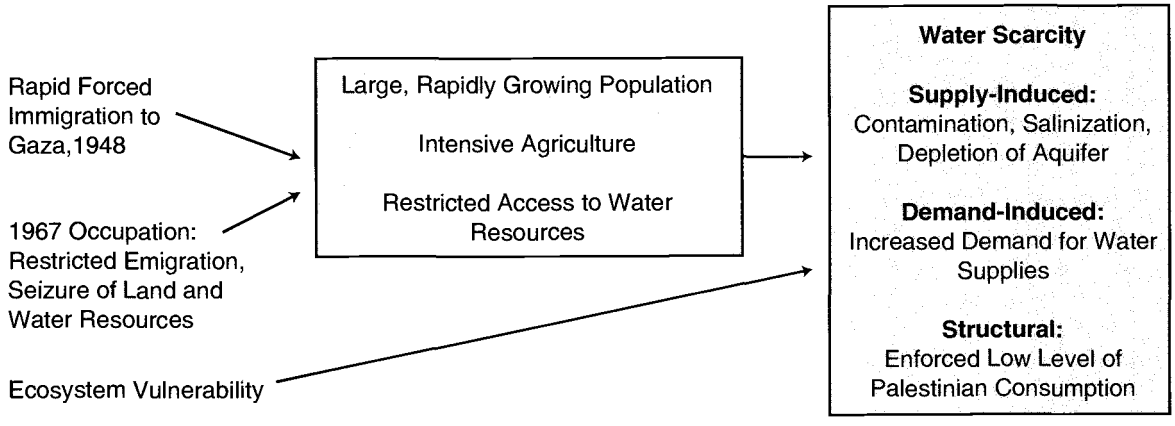
Ecosystem Vulnerability and Overall Availability

Gaza's climate ranges from semiarid in the north to arid in the south. The warm climate causes high potential enviro-transpiration,[32] between 1,040 and 1,900 millimeters per year (mm/year) for Gaza as a whole.[33] Of the average annual rainfall in Gaza (200-400 mm/year, which amounts to 117 million cubic meters (mcm) of total water from precipitation in Gaza's catchment area), only 40 percent is estimated to recharge the single freshwater aquifer underlying the territory, while the remainder is lost through surface runoff to the Mediterranean or to evaporation.[34] Another 30 mcm of recharge comes from agricultural return flow, wastewater infiltration, and groundwater flow from the east,[35] though the last may have decreased over the years due to a number of wells drawing reservoir water beyond the Green Line.

For its freshwater supply, Gaza relies almost entirely on groundwater drawn from its aquifer, with minimal amounts obtained from other sources, such as rooftop rainwater catchments.[36] Gaza's aquifer is often only a few meters from the surface. It is also shallow, ranging in thickness from 120 meters near the coast to 10 meters in the east.[37] Since it is near the Mediterranean and a deeper, highly saline aquifer,[38] it is vulnerable to declining water levels, saltwater intrusion, and contamination from agricultural and industrial activity. Estimates of the aquifer's renewable yield vary widely, ranging from 25 to 80 mcm per year, with around 65 mcm the most frequently quoted figure.[39]

Some analysts of the region suggest that the water crisis in Israel and the Occupied Territories is solely a consequence of structural scarcity — rather than of demand or supply pressures.[40] This argument may be valid if one considers the water inventory of Israel and the Occupied Territories as a whole. However, Gaza's aquifer is relatively self-contained, which means that its water inventory can be considered independently. Moreover, although the water resources in the entire region are sparse, on a per capita basis they are nonetheless relatively abundant compared with those in Gaza. Although there are serious distribution problems in Gaza, high population growth and years of heavy extraction

Figure 1: Water Scarcity in Gaza



have produced a crisis of absolute water availability.

Structural Scarcity

Discriminatory water allocation and pricing structures have significantly contributed to the present crisis in Gaza. Throughout the occupation, Israel practiced blatant and formalized discrimination regarding Palestinian water consumption in both Gaza and the West Bank. In 1967, Israel declared all water resources in the Territories to be state owned and under the jurisdiction of the military. Strict quotas were placed on Palestinian consumption. To preserve Gaza's aquifer under the occupation, Military Order 158 (which applied only to the Arab population of Gaza, and not to Israeli settlers) prohibited the drilling of new wells or the rehabilitation of existing wells for any purpose without a permit.[41] While restrictions applied to both Territories, limits may have been more difficult to enforce in Gaza, where the aquifer is close to the surface and relatively easy to access.

With the exception of minimal allowances for increased drinking-water demand, Palestinian pumping quotas were effectively frozen at 1967 levels.[42] Measures to limit Palestinian water consumption included the uprooting of thousands of citrus trees, demolition of cisterns, and the blockage of natural springs and existing wells. Throughout the intifadah, Israeli authorities reportedly cut off piped water to Gaza and the West Bank as an instrument of social control. Extended curfews often prevented Palestinians from having normal access to water for domestic and agricultural purposes.[43] As a result of a one-month curfew imposed on both Gaza and the West Bank in early 1991,

> *...some 2,500 dunums [250 hectares] of squash and additional dunums of fava beans were lost because farmers were not able to spray their crops at the appropriate times. Greenhouse agriculture on 10,000 dunums [1,000 hectares] in the Tulkarm region and in Gaza were also severely affected. The loss of grazing, brought on by drought conditions and exacerbated by the curfew has caused in one month estimated financial losses of $6 million.*[44]

Conversely, Israelis in the Territories and in Israel proper face fewer restrictions on water drawn from the same sources, and they consume on average eight to ten times more than the Palestinians.[45] These inequities have been a persistent source of tension. A UN report quotes a Palestinian farmer in Gaza:

> *Israeli authorities have forbidden anyone to dig a well to irrigate his citrus groves because "Gaza has no water." But at the same time, ten meters away on the other side of the 1967 border, they will dig not one well but ten. I myself have a farm and they have prevented me from digging a well on my own land, on the pretext that there is not enough water.*[46]

Israel has also allocated resources in its favor through the selective appropriation of agricultural land, placing settlements in the most favorable areas in terms of groundwater quantity and quality and in terms of underground flow.[47] In addition, several Israeli wells have been drilled in the catchment area of the coastal aquifer, which is inside Israel but along the border of Gaza. Palestinian water experts argue that these wells have reduced the flow of groundwater to Gaza.[48] This has, however, been a point of contention among hydrologists. Israeli sources argue that these wells are blocking the flow of saline water which could damage the aquifer. Others contend that these wells draw on a separate part of the coastal aquifer system and do not affect Gaza's aquifer at all.[49]

Uneven pricing schemes are another cause of structural scarcity. Although weak institutions and deteriorating infrastructure provide barely adequate quantity and quality of water, Gaza Palestinians pay much higher prices than do residents in Israel and Israeli settlers in the Territories. Settlers receive significant subsidies, paying $0.10 per cubic meter ($/m^3$) for water that costs $0.34/m^3$; Palestinians, who receive no subsidies, can pay up to $1.20/m^3$ for water from local Arab authorities.[50] Relative to per capita income, Palestinians pay as much as twenty times what Israeli settlers pay for water.[51]

This pricing system does not reflect the vulnerability of the region's water resources: the heavy

subsidization of Israeli farmers, especially in the Territories, promotes waste and overconsumption. Surprisingly, a large price differential also exists between the West Bank and Gaza for both Israelis and Palestinians; water is much cheaper in Gaza, yet the crisis there is far more severe.

The net effect of Israel's policies is to buffer Israelis from the effects of declining levels of water quality and quantity, while Palestinians bear the brunt of water scarcity. This inequity has contributed to a prosperous Israeli settler economy coexisting directly alongside a stagnant Palestinian economy. The consumption restrictions imposed on Palestinians and the widening water gap generate serious friction between these communities.

Demand-Induced Scarcity

Population size is possibly the most contested statistic for Gaza. As no proper census has been taken since 1967, available figures are approximate at best, and they tend to vary markedly, depending on the source and the purpose of the data.

The size of Gaza's current population is largely the result of the original refugee influx from the 1948 war. Approximately 70 percent of Gaza's population is made up of these refugees and their descendants.[52] Most contemporary sources place Gaza's current Palestinian population at 700,000 to 800,000, but these figures may underestimate the total by as much as 16 percent.[53] Most estimates of the present Palestinian population growth rate range between 5.2 and 6 percent,[54] among the highest rates identified for any group in the world. (Official Israeli estimates tend to be slightly lower; see Table 1.) Fertility tends to be higher for refugees than for residents, which means the fastest population growth is in the refugee camps — the areas that are also under greatest environmental stress.

Estimates of average population density range from 1,936 people per square kilometer (/km^2) to 2,055 people/km^2.[55] Densities are, again, much higher in the refugee camps; Jabalya camp, where the intifadah originated, has one of the highest population densities in the world at 100,000 people/km^2 in extremely poor living conditions.[56]

Table 1: Estimated Palestinian Population of the Gaza Strip, 1945, 1967–1992

YEAR	POPULATION (THOUSANDS)	NATURAL INCREASE (%)	NET EMIGRATION (%)
1945	72	—	—
1967	390	0.85	3.13
1968	381	2.18	8.48
1969	357	2.80	0.81
1970	364	2.58	0.91
1971	370	3.03	0.65
1972	379	3.22	1.06
1973	387	3.31	- 0.44
1974	402	3.56	0.45
1975	414	3.62	0.85
1976	426	3.78	0.99
1977	437	3.73	0.66
1978	451	3.75	1.04
1979	463	3.56	1.04
1980	445	3.80	1.15
1981	457	3.88	1.16
1982	470	3.79	0.66
1983	477	3.81	0.21
1984	495	4.08	0.97
1985	510	3.90	0.57
1986	527	4.10	0.68
1987	545	4.33	0.61
1988	566	4.53	0.48
1989	589	4.88	1.16
1990	610	5.05	-0.25
1991	643	5.12	-0.06
1992	676	5.03	-1.01
1993	717	—	—

Sources: 1945 figure from Sara Roy, *The Gaza Strip: The Political Economy of De-Development*, (Washington, DC: Institute for Palestine Studies, 1995), 49. Figures from 1967 (time of census) onward are from Israel's Central Bureau of Statistics, cited in The World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 6 (Washington, DC: The World Bank, 1993), 6.

Gaza's growing population and limited water resources are driving down per capita water availability. The Swedish hydrologist Malin Falkenmark has identified one thousand cubic meters per person per year as a "water barrier" for agricultural and industrial development. She defines this barrier as "the level of water availability below which serious constraints to development will arise."[57]

The ratio in Gaza — even using low population estimates and optimistic estimates of sustainable water supply — is considerably less than one hundred cubic meters per person per year.

Gaza's limited resource base also supports a number of Israeli settlements, which occupy an estimated 10 percent of Gaza's cultivated area.[58] Their residents are generally not incorporated in recent population figures. In 1993, the World Bank estimated that the Israeli population of Gaza was 4,000 to 5,000.[59] Surprisingly, this number may still be increasing, despite the autonomy agreement. The American Foundation for Peace in the Middle East has reported a 20 percent increase in the number of settlers in Gaza. The Yesha, or grand council of Jewish settlements, also has reported an increase of 10 percent in overall Israeli settler population, though this figure does not differentiate between the West Bank and Gaza.[60]

The lack of water for agriculture and industry has hamstrung economic development in Gaza for years, and it is especially burdensome now because of pressure on the PA to improve living standards. Gaza's economy relies heavily on agriculture, and particularly citrus agriculture, which is water intensive. Although steadily declining due to limits on water use, today citrus still makes up 55 percent of the total irrigated area, consuming roughly half of Gaza's agricultural water supply.[61]

Consumption of groundwater in Gaza consistently outstrips the sustainable supply of around 65 mcm per year. Estimates of present consumption for Gaza Palestinians range from 100 to 140 mcm per year[62] (85 to 100 mcm for agricultural purposes). Israeli consumption from Gaza's aquifer is a small fraction of total withdrawal; most sources estimate an average of between 4 and 10 mcm per year.[63] Yet average per capita domestic water consumption by Palestinians is less than one-tenth that of settlers: 137 compared with 2,000 cubic meters per person per year.[64] In general, consumption by settlements, promoted in part by subsidization, is thought to be excessive[65] in the context of the local water supply.

However, once again, data on the size of the Gaza groundwater deficit are soft. Of the 3,000 wells thought to exist in Gaza, some 500 to 700 have been illegally drilled (many since autonomy was implemented) and are drawing unknown amounts.[66] Decentralization of control makes accurate estimates of consumption almost impossible. In Gaza, administration of the water supply is the responsibility of a confusing hodgepodge of entities: individual operators of wells, Mekorot (an Israeli water company), the Gaza Agriculture Department, utilities, municipal and village councils, and the UNRWA, which supplies water to 20 percent of the population in the refugee camps.[67]

Some scholars suggest that with rapid population growth in Gaza, demand for drinking water alone may soon outstrip safe supply. It is also possible that Israeli settler demand will increase even if settlement population remains stable, due to "increasing per capita demands for both irrigated acreage and domestic amenities, such as grass and swimming pools."[68] Even if demand remains stable, Gaza's present water inventory may be in far worse shape than is implied by official figures: some experts suggest that pumping rates in Gaza are 1.5 to 2 times officially declared levels.[69]

Supply-Induced Scarcity

Gaza's limited water supply has been overexploited (mined) since the early 1970s, and probably since the period of Egyptian control.[70] The continuous mining of the Gaza aquifer, on average by an estimated 60 to 65 mcm per year, has caused falling water tables, salt intrusion, and chemical contamination.[71]

In its natural state, the top of the Israeli coastal aquifer, which is analogous to the neighboring Gaza aquifer, is 3 to 5 meters above sea level. Overpumping has reduced the Gaza aquifer to well below sea level and continues to draw it down by 15 to 20 centimeters per year.[72] This decline reduces the aquifer's hydrostatic pressure, allowing the infiltration of saltwater from the Mediterranean and

from saline aquifers below and to the east. Saltwater intrusion has already been detected as far as 1.5 kilometers inland. While levels of salinity vary geographically, Gaza's groundwater is generally classified as very saline, ranging from 650 to 3,600 parts per million (ppm).[73] Salinity increases an average of 15 to 20 parts per million per year.[74] This rapid increase has led some to predict the total salinization of the aquifer, if there is insufficient additional water to replace that lost to overpumping.[75]

Agricultural activity has resulted in chemical contamination of Gaza's groundwater.[76] Unregulated use of pesticides, herbicides, and fertilizers contributes to severe pollution, especially since the aquifer is close to the surface. Chemicals banned from use in Israel and elsewhere, such as DDT, are often used in Gaza — and often misused because there are no Arabic labels on their containers.

As a result, Gaza's groundwater is often unsuitable for irrigation, as it can damage the soil and lower crop yields.[77] Salinity is the greatest concern and in Gaza most groundwater is suitable only for use on highly salt-tolerant crops and highly permeable soil. Yet citrus is a significant agricultural crop and, in addition to being water intensive, citrus cannot tolerate high salinity. Farmers are already seeing declining crop yields and declining quality in many areas due to the use of high salinity irrigation water.[78]

Experience elsewhere shows that farmers can adapt to such contamination by shifting to more-salt-tolerant crops, adding gypsum and organic matter to the soil, and applying excess clean irrigation water to flush the soil of salt.[79] However, with current limits on water consumption and a chronic lack of capital for the farming sector, these measures may not be feasible.

Inadequate disposal of waste matter has also contributed to the contamination of Gaza's aquifer. Ten percent of Gaza's population is not served by any wastewater management system, and is simply dumping raw sewage onto sand dunes.[80] What systems are in place remain inadequate, particularly in the refugee camps (see Table 2). Public latrines are still widely in use, and the majority of the population throughout Gaza relies on septic tanks and soaking pits. These frequently overflow into lanes, streets, and homes and pose a significant health hazard.[81] Furthermore, only one-third of Gazans outside of the refugee camps are served by solid waste collection; and while all of the refugee camps do have collection services, proper sanitary landfill sites have not been constructed

Table 2: Wastewater Situation in Selected Gaza Localities, 1993-1994[82]

LOCALITY	ESTIMATED POPULATION	WATER-WORKS STAFF	PERCENTAGE OF POPULATION SERVED	TREATMENT FACILITY	DISPOSAL SITE OR METHOD
Gaza City and Beach Camp	344,999	26	85	Aeration and stabilization ponds	Wadi Gaza and into the sea
Jabalya	94,710	18	70	Oxidization ponds	Sand dunes
Beit Lahia	20,000	7	15	None	Sand dunes
Beit Hanoun	17,000	4	Unknown	None	Outside municipal borders
Rafah	101,926	21	20	Oxidization ponds	Pumped to the sea
Khan Yunis	160,463	23	30	None	Cesspools
Deir-El-Balah	38,000	5	Unknown	None	Cesspools
Abasan	12,000	6	Unknown	None	Cesspools
Khuza'a	4,500	2	Unknown	None	Cesspools
Bani Suhaila	20,000	3	Unknown	None	Cesspools
Nuseirat Camp	35,500	1	Unknown	None	Cesspools
Bureij Camp	22,500	2	Unknown	None	Cesspools
Maghazi Camp	15,000	3	Unknown	None	Cesspools

Sources: Population figures from Sara Roy, *The Gaza Strip: The Political Economy of De-development* (Washington: Institute for Palestine Studies, 1995) 15-16. Wastewater capacity figures from Ramzi Sansur, *Environment and Development Prospects in the West Bank and Gaza Strip* (New York: UN Conference on Trade and Development, 1995).

anywhere in Gaza.[83] As a result of inadequate infrastructure, both sewage seepage and leachate from solid waste disposal and have contaminated the aquifer.

According to one relatively optimistic analyst, 50 percent of Gaza's drinking-water supply is "murky," and 23 percent is not potable at all.[84] The Applied Research Institute in Jerusalem (ARIJ) is far more pessimistic, maintaining that Gaza groundwater is simply not fit for human consumption. A water quality survey conducted by ARIJ in 1992 identifies concentrations of several key substances that far exceed what are generally regarded as acceptable levels for potability (see Table 3). A similar study conducted between 1987 and 1994 by UNRWA and the Palestinian Health Authority determined that every one of Gaza's 60 drinking water wells exceeded acceptable levels for at least two tested contaminants (see Table 4).[85] While extensive testing for many toxins has not been conducted, several analysts have expressed concern about the in-

Table 3: Potability of Groundwater in the Gaza Strip

DISSOLVED SUBSTANCES	ACCEPTABLE CONCENTRATION* (ppm)	GAZA CONCENTRATION (ppm)
Total Dissolved Solids	500	1,200 - 3,200
Sodium (Na^+)	20	300 - 1,100
Chloride (Cl^-)	250	400 - 1,500
Calcium (Ca^{+2})	36	40 - 120
Sulfate (SO_4^{-2})	250	50 - 400
Magnesium (Mg^{+2})	30	40 - 120
Bicarbonate (HCO_3^-)	225	300 - 700
Potassium (K^+)	4	6 - 10
Nitrate (NO_3^-)	45	40 - 140
Fluoride (F)**	1.5	0.4 - 2.9

Source: Hisham Zarour, Jad Isaac, and Violet Qumsieh, "Hydrochemical Indicators of the Severe Water Crisis in the Gaza Strip," in *Final Report on the Project Water Resources in the West Bank and Gaza Strip: Current Situation and Future Prospects* (Jerusalem: Applied Research Institute in Jerusalem, 1994).

* World Health Organization standard levels.

** Fluoride figures drawn from Zaher Kuhail and Zaki Zoarob, *Potable Groundwater Crisis in the Gaza Strip, 1987–1994* (UNRWA and Palestinian Health Authority, 1994), 11.

Table 4: Suitability of Drinking Water Wells in the Gaza Strip

MATERIAL	SUITABLE WELLS*	PERCENTAGE OF SUITABLE WELLS
Total Dissolved Solids	23	39.7
Sodium	27	46.6
Chloride	24	41.3
Calcium	46	79.3
Sulfate	52	90.0
Magnesium	57	98.3
Potassium	32	55.2
Nitrate	0	0
Fluoride	47	80.0
Hardness	6	10.3
Alkalinity	0	0

Source: Zaher Kuhail and Zaki Zoarob, *Potable Ground Water Crisis in the Gaza Strip, 1987-1994* (UNRWA and the Palestinian Health Authority, 1994), 31.

* Out of total of 60 drinking water wells in Gaza.

filtration of heavy metals, fuels, toxic organic compounds, fertilizers, pesticides, and herbicides into Gaza's drinking water supply.[86] Some analysts estimate that the contamination is already irreversible and that Gaza's population will soon have to find alternate sources of drinking water. At present, however, there are few other sources.[87] Overall, contamination and salinization have been costly, — politically, economically, and in terms of public health.

SOCIAL EFFECTS OF ENVIRONMENTAL SCARCITY

Health Impacts

Anthropologist Anna Bellisari argues that the routine consumption of contaminated or saline water by Gaza Palestinians contributes to deterioration of the overall health of the population:

> *The water crisis is very costly to Palestinians not only in the agricultural and industrial sectors, but especially in terms of public health, which depends largely upon adequate, safe supplies of domestic water. Water shortages and pollution are responsible for a major portion of the acute and chronic infections widespread throughout the Occupied Territories, and are likely to cause permanent health damage to a large segment of the population.*[88]

This conclusion is supported by a recent World Bank report, which suggests that inadequate and contaminated water supplies contribute to the high incidence of gastrointestinal and parasitic infections found in Gaza. There are no studies that provide decisive proof, but preliminary evidence suggests a causal link between scarce and contaminated drinking water and Gaza's high levels of infant mortality, infectious disease, hypertension, and other health-related problems.

If the salinity of Gaza's aquifer continues to rise, eventually its water will be undrinkable. Salinity levels of Gaza groundwater range from 650-3,600 ppm. The U.S. standard for drinking water is 500 ppm, and water over 1,000 ppm is considered saline. Sea water has a salt concentration of 35,000 ppm. A maximum physiologically tolerable level of salinity in drinking water cannot be identified; sodium intake in water must be considered as a component of overall dietary intake. Ten grams per day is the maximum recommended salt intake for adults who are healthy, well-nourished, and not predisposed to hypertension or other salt-sensitive disorders. This level is also based on the presumption that the individual has access to sufficient fresh water to flush excess sodium: at best, human kidneys can concentrate urine to 6 grams of sodium per liter of water. Sodium intake in excess of this level must be flushed in order to keep plasma sodium levels normal. It is recommended that people with hypertension or cardiovascular disorders (both of which are common in Gaza) should not exceed 20 ppm sodium in their drinking water. Anything above that level is considered a major salt component of their diet.[89]

Some experts think that high salt concentrations are already producing adverse health effects: "Gaza physicians are convinced that salty water is responsible for the high incidence of kidney and liver complaints among Gaza residents."[90] Salinity has also been linked to hypernatremia,[91] thought to be responsible for a large percentage of "crib deaths" and early brain damage.[92] In recent years, nitrate contamination of Gaza's drinking water has increased rapidly: in 1987, 84 percent of Gaza's drinking water wells were considered suitable for drinking in terms of nitrate levels; by 1994, not a single safe well remained.[93] Elevated nitrate levels are also suspected of contributing to infant mortality by causing acute anemia or "blue baby disease."[94] Severe cases can result in anoxia (oxygen deprivation) and death. Nitrates have also been linked to cancer and to increased incidence of spontaneous abortion, both in humans and in animals.[95]

Gaza Palestinians are exposed to high fluoride concentrations in their groundwater and also in the fish and the tea that are staple foods. When consumed in large amounts, fluoride is toxic and contributes to ulcers, kidney failure, soft-tissue calci-

fication, and skeletal and dental fluorosis.[96] The effects in Gaza of groundwater chemical pollution from fertilizers, pesticides, and herbicides are hard to establish, because data on concentrations and health impacts are not available. However, studies in the West Bank show that absorption through the skin or ingestion of such chemicals can damage the nervous system.[97] Similar products and practices are used in Gaza, so it follows that similar impacts may be present there. While aquifer concentrations are probably not high enough to produce extreme results, we should not rule out serious health effects because of sustained low-level exposures.

The most prevalent and serious health problem in Gaza is infectious disease caused by waterborne bacteria, viruses, and parasites. These diseases largely result from poor personal hygiene and inadequate sewage disposal, which are, in turn, exacerbated by insufficient water for washing and waste removal.[98] Moreover, open sewers are common in urban areas. Thus in November 1994, heavy rains caused sewage to mix with freshwater supplies, producing an outbreak of cholera in Gaza City, with fifty cases and one death in a week.[99]

Although this outbreak received widespread attention, infectious disease is common in Gaza: "The Union of Palestinian Medical Relief Committees, which operates clinics in the Gaza Strip and in the West Bank, reported that three-quarters of all clinic patients suffered from infectious diseases, which were responsible for 74 percent of all childhood deaths."[100] Intestinal parasites are prevalent. Researchers at Birzeit University found that 50 percent of Gaza children suffered from roundworms. However, according to Bellisari, these infections are often considered to be a fact of life rather than a pressing health concern, so many people may not seek treatment. Fungal infections and various other skin conditions due to poor personal hygiene are also common. These diseases are worst in refugee camps, where poor sanitation is magnified by overcrowding.[101]

The World Bank estimates that 7 percent of Gaza's GNP is allocated to health concerns, but there is little sign of improvement in overall population health.[102] According to Bellisari, without clean and ample water supplies, disease will recur as fast as it is treated, and resources will remain focused on symptoms and not on prevention.[103] Thus, Gaza's health care system will remain overburdened, producing strain on the limited resources of the PA and frustration among patients and health care workers.[104]

Agricultural Decline

Agriculture is key to Gaza's economy but has been in relative decline since the middle of the 1970s.[105] The percentage of the total workforce employed in agriculture dropped from 31.8 in 1968 to 18.3 in 1988. Between 1981 and 1991, per capita agricultural GDP dropped from approximately $5,235 to $4,330.[106] When considered by themselves, these figures could be interpreted as signs of economic growth: the decline of agriculture relative to other sectors of the economy, such as industry and services, is often a hallmark of a developing economy. However, in the case of Gaza, other economic sectors grew too slowly to absorb any significant percentage of labor moving out of agriculture. The overall result of agricultural decline in Gaza has not been economic development, but rather increased poverty and economic dependence on Israel.

Agricultural decline in Gaza is in part a result of water scarcity. Discriminatory allocation policies and the contraction and degradation of the water supply interact to produce significant reductions in crop yields. During the occupation, Israeli policy not only limited Palestinian water consumption for agriculture, but also restricted the cultivation of water-intensive crops. In some cases, Israeli authorities even uprooted Palestinian fruit trees: between 1973 and 1987, for example, about 700 hectares of citrus trees were uprooted in the Territories. To protect Israeli production from competition, exports from Gaza were heavily restricted; furthermore water resources were allocated to Palestinians on the basis of soil conditions and type of crop.[107] Today, production is heavily influenced by trade imbalances that have their roots in the

occupation. While Israel restricts imports of Gaza crops that compete with Israeli produce, Israel sells freely in the Occupied Territories.[108] Israel exports "substantial quantities of fruits and vegetables at prices with which Gazan farmers have been unable to compete."[109] Previously a net exporter of agricultural produce, Gaza has been a net importer since 1984 (see Table 5).

Water scarcity and imbalanced trade have affected citrus production. The area under citrus cultivation contracted steadily from the early 1970s to the mid-1980s. Productivity per hectare also appears to have declined (see Table 6).[110] In the late 1980s, citrus production accounted for only 20 percent of the value of agricultural output, down from 50 percent in the previous decade.[111] This drop in production has affected other sectors of Gaza's economy, such as processing. "Many orchards lie abandoned because water salinity is too high for the crop. Today it is uncertain whether Gaza citrus production can utilize the full capacity of a newly constructed orange juice production plant."[112]

Israel claims that agriculture in Gaza expanded under the occupation. The Israeli claim may be based on a steady increase in the area used for vegetable production: from 300 hectares in 1967 to 4,800 in 1985–86. While the output of all fruits, including citrus, has declined from a 63 percent share of total agricultural value in 1969 to 27 percent in 1990, vegetables have increased from 14 to 50 percent in the same period. Vegetable crops are less water intensive and more salt tolerant, but they are also less productive (particularly in rain-fed areas) and more labor intensive. Profitability of vegetables has suffered because some export markets (for instance, Jordan) have imposed annual quotas, and competition has increased.[113]

Water scarcity has also adversely affected grazing areas and animal husbandry. Although livestock increased its share of total agricultural value from 21 percent in 1969 to 30 percent in 1990,[114] military constraints on land use and overgrazed rangeland have combined with water scarcity to limit real growth in this sector.[115] The greatest growth has occurred in the area of poultry production;

Table 5: Surplus of Agricultural Exports over Imports in Gaza

YEAR	VALUE (MILLIONS OF DOLLARS)
1972	10.7
1973	10.5
1974	11.9
1975	18.5
1976	17.1
1977	29.1
1978	13.0
1979	27.9
1980	25.4
1981	19.1
1982	13.3
1983	1.8
1984	-14.3
1985	-10.3

Source: Israel Central Bureau of Statistics, cited in David Kahan, *Agriculture and Water Resources in the West Bank and Gaza, 1967–1987* (Boulder, Colo.: Westview Press, 1987) 162.

Table 6: Citrus Branch Changes — Gaza

YEAR	AREA UNDER PRODUCTION (HECTARES)	TOTAL YIELD (TONS)	YIELD/ HECTARE (TONS)
1967/68	3,500	91,000	26.0
1971/72	6,300	176,400	28.0
1973/74	7,200	197,000	27.4
1974/75	7,000	210,000	30.0
1975/76	7,000	243,000	34.7
1977/78	7,000	186,000	26.6
1978/79	7,000	189,000	27.0
1979/80	7,000	172,100	24.6
1980/81	7,158	179,300	25.0
1981/82	7,147	201,300	28.2
1982/83	6,920	166,500	24.1
1983/84	6,671	159,500	23.9
1984/85	6,600	175,700	26.6
1985/86	6,534	137,000	21.0
1990/91	NA	134,000	NA
1991/92	NA	119,300	NA
1992/93	NA	109,900	NA

Source: Judea, Samaria and Gaza Area Statistics: Agricultural Branch Accounts, Central Bureau of Statistics. Cited in David Kahan, *Agriculture and Water Resources in the West Bank and Gaza 1967–1987* (Boulder, Colo.:Westview Press, 1987), 144. Figures from 1990 onwards from Central Bureau of Statistics, *Statistical Abstract of Israel,* (1994).

more profitable types of livestock, such as cattle and sheep, have remained comparatively limited (see Table 7).

In sum, water scarcity has hampered agriculture in Gaza, discouraged investment and forced many Gazans to look for off-farm work. Hydrologist Gwyn Rowley writes, "The net effect [of water scarcity] is that carrying capacities and herd sizes are diminished and crop outputs are reduced or fail and the population has to 'move on,' for example, with younger elements seeking employment elsewhere as in urban areas."[116]

Economic Decline

Industry now accounts for a larger share of Gaza's GDP than prior to the occupation, rising from 4.4 percent in 1965 and 1966 to 12.2 percent in 1990. But overall industrial growth in Gaza has been slow, well behind the pace of "similar" cases, according to the World Bank.[117] As a result, labor has moved from agriculture to wage employment in Israel rather than into other sectors of Gaza's economy (see Table 8).

A recent World Bank report says that the increase in migrant labor during the occupation was simply a function of "pull" factors in Israel: "Following the occupation, major changes took place; Occupied Territories workers were allowed to seek employment across the 'Green Line' which ultimately created a massive drain of people out of the agricultural sector."[118] This perspective neglects the "push" side of the process. While it is likely that the prospect of wage labor in Israel is attractive to some Palestinians,[119] the lack of economic opportunities in Gaza also contributes to the movement of labor.

An exclusive focus on pull motivations also ignores the role that Israeli policy in Gaza played in creating the migrant labor economy. Policies that enforced low levels of water consumption made agriculture "a burden rather than a source of income and jobs." Restrictions on development in other sectors of the economy contributed to general stagnation. As a result, local job opportunities were rare, and by 1994 more than 140,000 out of 2 million Palestinians in the Occupied Territories had, at some point, worked in Israel.[120]

Table 7: Composition of the Livestock Branch in Gaza

YEAR	CATTLE (HEAD)	SHEEP (HEAD)	POULTRY (UNITS)
1966	10,000	10,000	10,000
1972/73	5,500	50,000	508,000
1973/74	5,300	45,000	510,000
1974/75	5,500	40,000	420,000
1979/80	6,000	40,000	125,000
1982/83	3,600	33,000	2,046,000
1984/85	3,618	28,900	2,045,000
1985/86	3,200	25,374	2,500,000

Source: Statistical Abstract of Israel 1986, cited in David Kahan, *Agriculture and Water Resources in the West Bank and Gaza 1967–1987* (Boulder, Colo.: Westview Press, 1987), 146.

Table 8: Gaza GDP by Sector and Percentage of GNP from Foreign Sources, 1966 and 1987

SECTOR	PERCENTAGE OF GDP 1966	PERCENTAGE OF GDP 1987
Agriculture	34.4	17.3
Industry	4.2	13.7
Construction	6.2	69.0
Services	55.2	
NET FACTOR INCOME FROM ABROAD	**PERCENTAGE OF GNP 1966**	**PERCENTAGE OF GNP 1987**
Remittances from Abroad and Transfer Payments from UNRWA	24	7
Employment in Israel		42

Sources: Fawzi Gharabibeh, *The Economics of the West Bank and Gaza Strip* (Boulder, Colo.: Westview Press, 1985), 17, and Sara Roy, *The Gaza Strip: The Political Economy of Dedevelopment* (Washington, DC: Institute for Palestine Studies, 1995) 223, 237, 251.

The dependence on wage labor in Israel is a strong contributor to the current economic crisis in Gaza. If population growth and agricultural decline were responsible in large part for the territory's economic instability, Israeli border closures have triggered an economic debacle. In 1994 alone, closures produced an estimated loss of $400 million in earnings in the Occupied Territories.[121] The

impact has been proportionately greater in Gaza, which is much poorer than the West Bank. Prior to the intifadah, close to 70 percent of Gaza's workforce was employed in Israel. In January 1994, this number was 11 percent (see Table 9).[122] Not only has the migrant labor economy collapsed, so too have the support services that grew out of it. The remainder of Gaza's economy has been unable to absorb this new wave of jobless Palestinians. Unemployment is currently estimated at 60 percent;[123] among working males, underemployment is around 38 percent.[124]

Faced with the task of creating a stable political structure within a territory that has been in upheaval for decades, the fledgling PA found itself woefully ill equipped to deal with the additional burdens of an exploding population and a shrinking resource base. A little over a year after the signing of the Accord, initial elation had faded. "We can now go freely to the beach," one resident said, "but we have also never been so badly off in economic terms."[125] The hardship faced by Gazans perpetuated the long-standing resentment of Israel; it also contributed to the emergence of dissatisfaction with Arafat's regime.

Legitimacy and Control

The 1990s have been years of rapid change in the Middle East. Elements of the following analysis may therefore be quickly superseded by events. Yet it remains likely that unless an alternate source of fresh water is developed, water scarcity in Gaza will continue to place real constraints on economic development and threaten political and social stability. The Gazan case appears to support the hypothesis that environmental scarcity can simultaneously increase economic deprivation and disrupt key social institutions, leading to civil strife and insurgency.[126]

> *To cause civil strife, economic crisis must be severe, persistent, and pervasive enough to erode the legitimacy or moral authority of the dominant social order and system of governance. System legitimacy is therefore a critical intervening variable between rising poverty and civil conflict. It is influenced by the aggrieved actors' subjective blame system, which consists of their beliefs about who or what is responsible for their plight.*[127]

Table 9: Estimated Number of Gazans Employed in Israel, 1987–1995

DATE	NUMBER EMPLOYED
December 1987	80,000
January 1993*	32,200
January 1994	15,400
February 1994	13,900
April 1995	8,000-10,000

Sources Sara Roy, "The Seeds of Chaos, and of Night: The Gaza After the Agreement" *Journal of Palestine Studies* 23 no. 3 (Spring 1994) and Sara Roy, "Alienation or Accommodation?" *Journal of Palestine Studies* 24 no. 4 (Summer 1995).
*Prior to the March 1993 border closure.

While the majority of Gazans continue to hold Israel accountable for the conditions under which they live, it is clear that Arafat's administration is being held accountable as well (see Figure 2 on page 18). The survival of the PA in Gaza rests on its ability to balance the dual objectives of achieving legitimacy in the eyes of Gazans and achieving the stability demanded by Israel. In these early years of autonomy, the latter objective seems to be the priority: Arafat's authority derives more from his police force as popular support for his administration wavers.

In major population centers, Palestinian police have replaced Israeli soldiers as the immediate source of authority. Arafat's ability to serve simultaneously as an effective administrator and as a nationalist icon is in question. Diaspora Palestinians see Arafat as a distant local leader who has lost the ability to represent their interests internationally; many Gaza Palestinians see him as an autocrat committed to a peace process that ignores their immediate economic needs. Arafat risks becoming a "Mr. Palestine increasingly disowned by Palestinians."[128]

Opposition in the Diaspora

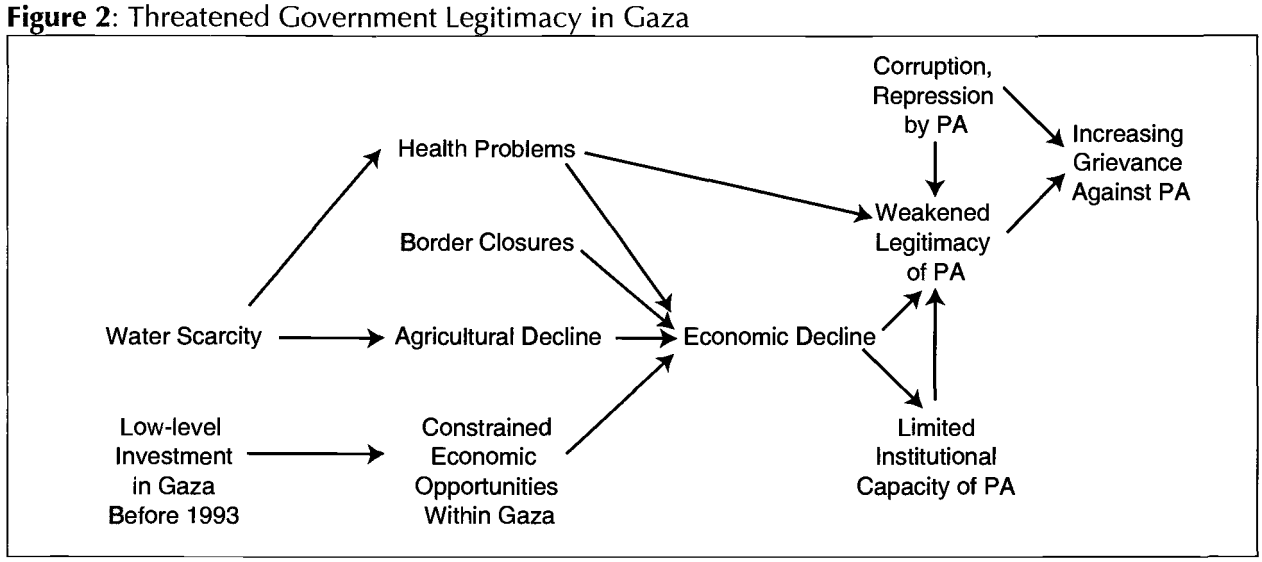
As the prominent Palestinian poet Mamoud Darwish has written: "The irony of history is that Israel has adopted the old Palestinian formula — namely, that no solution is possible without the PLO."[129] But the more loudly the Israeli government proclaims Arafat and Fatah to be its partners in the peace process, the more dissension arises within the ranks of the Palestinian national-

ist movement as to whether the peace process legitimately represents the movement's interests. Certainly, as an umbrella organization, the PLO has always contained opposition groups; these include the left-wing splinter groups the Popular Front for the Liberation of Palestine (PFLP), the Democratic Front for the Liberation of Palestine (DFLP), and the People's Party (PPP) (formerly the Communist Party). Prior to the Accord, none of these groups questioned Arafat's legitimacy. Today, however, these parties, and even members of Fatah, are calling for a rehabilitation of the image of the PLO within the nationalist movement. Some believe this rehabilitation requires the movement to distance itself from Arafat.

Arafat's autocratic methods are one significant source of intraparty friction. He has continually delayed adopting a more democratic structure within Fatah. Party elections in Gaza were postponed after similar elections in Ramallah, West Bank resulted in the defeat of almost all Arafat appointees. Arafat has since overturned these results.[130] A 1994 meeting of the PLO executive became a protest against his leadership when only eight of eighteen members participated.[131] Shafiq al-Hout, PLO ambassador to Lebanon, who resigned from the executive shortly after the Accord was signed, is a member of a newly formed opposition group called the National Coalition. "Arafat is simply irreformable," he says. "There is no alternative to the PLO. But how can we rescue this organization now hostage to Arafat and Gaza? We think that the way out is to get Arafat to choose between leading his National Authority in Gaza and Jericho or leading the PLO."[132]

The direction of the ongoing peace talks with Israel is another cause of opposition. Many Palestinians fear that the power imbalance between Israel and the PLO at the bargaining table has translated into a series of agreements that protect Israeli interests without producing commensurable gains for Palestinians. The recent agreement on limited autonomy for the West Bank is a significant step forward; however, opposition groups within the PLO immediately labeled the agreement "a disaster" and expressed concern that the terms of transfer are flawed and heavily biased toward Israel.[133] Skepticism surrounds the upcoming talks on the "difficult" issues of the right of return for Palestinian refugees, water, the future of Israeli settlements, and the fate of Jerusalem. From the perspective of some Palestinian nationalists, Arafat appears to be bargaining from a position of tremendous weakness: having recognized Israel and renounced the Palestinian use of violence, he is seen as having given up the main source of Palestinian bargaining power. For many, Arafat has traded away the PLO's overriding goal of an independent state for all Palestinians in order to ensure that he maintains leadership in Gaza.

Figure 2: Threatened Government Legitimacy in Gaza



Opposition in Gaza

The dissension within the PLO has significant implications for politics within Gaza, as the organization no longer serves in any meaningful respect as a source of unity. Parties once united under the PLO represent themselves separately in Gaza, and popular support for the PLO is split among them (see Table 10). Palestinian allegiance to the PLO has translated into widespread support for Arafat; most Gazans still express great affection for Arafat as the unquestioned leader of the nationalist cause. This affection does not, however extend to the PA as a whole and, as a result, Arafat's position in Gaza is not secure. From the outset, many Gazans, especially those who fought in the intifadah, saw Arafat's administration as "outsiders." The years of PLO exile resulted in a leadership with weak ties to its constituents, as illustrated by the comments of one of Arafat's aides regarding the "uneasy" return of the PLO to Gaza: "We're scared... . We don't know those people and they don't know us."[134] Some of the policies pursued by the PA since the transfer of authority have done little to bridge this gulf.

Table 10: Political Factions and Support, West Bank and Gaza, 1994

AFFILIATION	PARTY	SUPPORT (%)
PLO	Fatah	40
	Popular Front for the Liberation of Palestine	7-8
	Democratic Front for the Liberation of Palestine	
	People's Party	5
Islamists	Hamas	
	Islamic Jihad	15-20
No Affiliation		30

Source: Dan Connell, "Palestine on the Edge: Crisis in the National Movement," *Middle East Report* 25, no. 3/4 (May–August 1995.)

Arafat's patronage system has created suspicion that international aid is being misallocated. The PA says that less than 20 percent of a promised $2.1 billion in aid has actually reached Arafat's administration. Of this sum, the majority has undoubtedly gone to meet the payroll of the PA's vast bureaucracy of 20,000 soldiers[135] and 28,000 civil servants,[136] with the result that little remains for investment in infrastructure and development. There is widespread resentment of the PA's financial agenda: "We know that Arafat gets money, but we don't know where it goes, into his pocket or to his friends. We don't see any of it."[137]

The exclusion of the majority of Gazans, and especially veterans of the intifadah, from political structures has exacerbated these grievances. The transition to limited self-government has only slowly provided a nonviolent channel through which Gazans can express their political will. The achievements of the peace process, significant as they are, do not in themselves provide a stable long-term basis of support for Arafat's government.

THE ISLAMIST ALTERNATIVE AND VIOLENCE IN GAZA

While Fatah maintains majority support within Gaza and the West Bank, significant elements of opposition are evident. The PA's weakened legitimacy at first appeared to increase support for "radical" Islamist groups. Tensions between the PA and Islamists came to a head in November 1994, when sixteen died and two hundred were wounded in an eruption of hostilities between Arafat's police and supporters of Hamas and Islamic Jihad.[138] In August 1995, an estimated one thousand protesters again violently confronted Palestinian police who were trying to arrest suspected Hamas leaders.

Incidents of this scale are not regular occurrences in Gaza, but political unity under the PLO has disintegrated; factionalism is rife as the realities of life under limited autonomy take shape. A major factor producing support for the Islamists is the ongoing economic crisis of the territory. It is simplistic and misleading to ascribe popular support for Islamist groups to the religious fervor of Palestinians within the territories or to a "global" expansion of Islam.

Three main Islamist groups operate in the Occupied Territories: Hamas, Islamic Jihad, and Tahrir. An elitist, ideologically oriented sect, Tahrir is not significantly involved in Palestinian politics. Islamic Jihad is notorious for several recent terrorist attacks. It focuses almost exclusively on violent action rather than on expanding its popular base in Gaza and the West Bank. Thus it is Hamas that is the major political threat to Arafat's PA.[139]

Like Islamic Jihad, Hamas has become notorious since the Accord was signed for a series of suicide bombings against Israelis in both Israel and Gaza. Western media coverage has focused exclusively on these activities, which were conducted by the organization's military wing, 'Izz al-Din al-Qassam. The media have not acknowledged what some have called the "other face of Hamas." There is a tangible basis for the group's popularity: it tries to provide some social and economic support for Gaza's population. Islamic groups are, by most accounts, relatively wealthy. In addition to significant contributions from the diaspora,[140] they are still able to obtain funds from Arab regimes in the Persian Gulf states that cut off support to the PLO.[141] In some communities, Hamas provides monthly allowances to poorer families and loans for medical expenses, education, and businesses. It has put in place a network of charities to support free hospitals, schools, orphanages, and clinics.[142] While Arafat's political achievements have won him considerable acclaim, within Gaza, Hamas's social activities may have a more immediate impact on an impoverished population.

At one point in mid-1994, almost one-third of Gaza's population claimed to support Hamas.[143] While that percentage has since diminished considerably, Arafat recognizes the power of Hamas and keeps open a line of communication with the organization's moderate political wing. Some say this wing is adapting itself to become a legitimate party in future elections.[144]

'Izz al-Din al-Qassam, however, has shown little interest in adapting to politics under the PA. The horrific, and much-publicized terrorist bombings for which Hamas has openly claimed responsibility initially garnered considerable popular support in the Territories. The first few attacks were followed by massive rallies to commemorate the suicide bombers, who were held up as role models. Gazan children traded and collected pictures of the bombers like baseball cards. But such popular public endorsement has all but disappeared. The militants' activities are undermining support for Hamas as a whole: Israel's total closure of the Territories after each attack cuts off thousands of Palestinians from their livelihood, exacerbates poverty, and turns many Palestinians against the Islamists. This has not, however, translated into greater support for the PA; the fastest-growing percentage of Gazans is that which claims disillusion with *all* political parties.

Nonetheless, a poll in July 1995 indicated that 30 percent of Palestinians in the West Bank and Gaza still supported the suicide attacks.[145] This suggested an Israeli policy of tight border restrictions may, in the long run, actually reduce Israeli security. By weakening Gaza's economic base further, increasing frustration, and undermining Arafat's legitimacy, such a policy will exacerbate grievances within Gaza, grievances that could eventually catalyze even greater violence against Israel.[146]

Even if Israel were to completely close off Gaza, radical Palestinians would still have opportunities for violence against Israeli targets because of the continuing presence of settlements. These settlements occupy a significant amount of territory, and as the quantity and quality of Gaza's natural resources deteriorate, they may become the focus of additional violence. The relative luxury of the settlements — some have spacious lawns and swimming pools[147] — provides an immediate comparison point and a powerful source of resentment in light of the poor conditions faced by most Gazans.

Threats to the security of Israelis may, however, be less direct. As the presence of Israeli soldiers declines in autonomous areas of Gaza, the high levels of social frustration in Palestinian society may instead be focused on internal Palestinian targets, leading to more intra-Palestinian violence in the Territories (see Figure 3 on page 21). Israel's insistence that Arafat suppress the Islamist movement in Gaza already is a major source of intra-Palestinian friction. Israel is suspicious of the mass

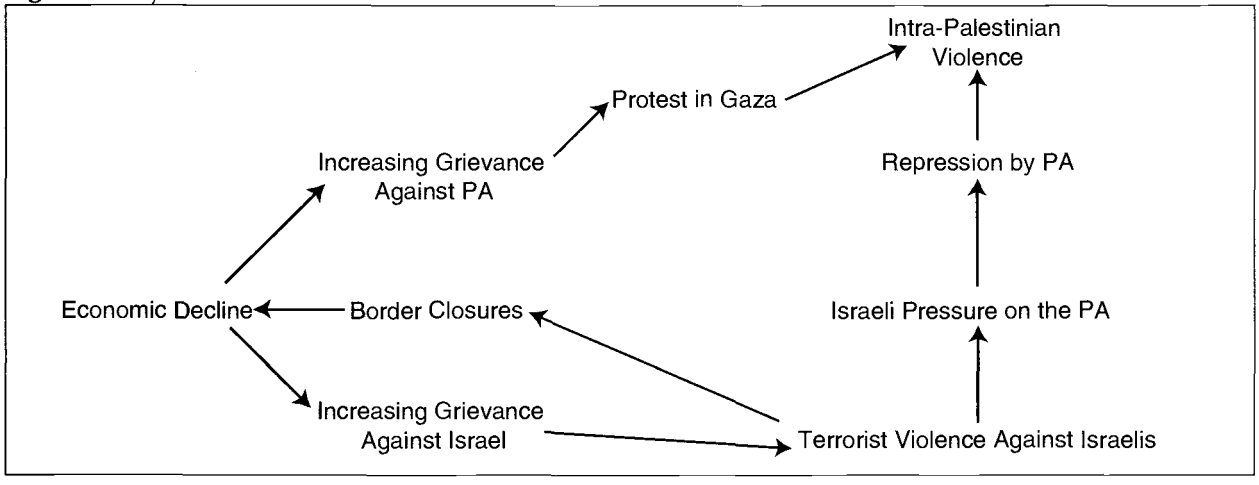
arrests of Hamas's supporters after each terrorist incident, as charges are rarely laid and as Arafat refuses to extradite suspects. Nonetheless, the sweeps — which often result in gun battles between the police and the Islamists — have damaged Arafat's image in Gaza, and there have been calls for him to stop "hounding Hamas's holy fighters."[148] Recent accusations of human rights abuses and torture of Palestinians by the PA's secret services in Gaza and Jericho have further undermined the image of the administration.[149]

Grievance has not, at present, been redirected from Israeli targets toward the Palestinian police on a significant scale. However, many young people in Gaza, having grown up under the occupation, have an entirely negative perception of authority.[150] The authoritarian actions and conspicuous consumption of the PA have done little to alter this perception. The PA risks being seen — especially among Palestinian youth — as the continuation of Israeli occupation.

At present, most Palestinians oppose the ascendancy of conservative Islamists. The lack of a widely acceptable alternative to Arafat's government has resulted in political apathy rather than political revolt. Now that the nationalist unity that endured for so long under the PLO has largely evaporated, many Palestinians are left with a sense of hopelessness. Dr. al-Masri writes:

> *Our own society is somehow committing suicide,...Look at our streets — we are neglectful of everything. There is a depression in this country. At social gatherings you hear people talking about basic needs, political and economic problems, but there is no mention whatsoever of the future.*[151]

Figure 3: Dynamics of Violence in Gaza



CONCLUSIONS

Early 1996 provided a break in this atmosphere of political apathy in Gaza. On January 20, Palestinians in Gaza, West Bank, Jericho and East Jerusalem voted in the first Palestinian general elections. Turnout in Gaza was extremely high, estimated at 85 percent of registered voters. This showing was interpreted as a rebuff against Hamas, who had called for a boycott of the election process. Arafat, as expected, won an overwhelming majority - 88 percent of the vote for the presidency - and Fatah is expected to dominate the 88-member legislative council.[152]

Amid the excitement surrounding the elections, several observers were cautiously optimistic about the difficult transition from authoritarianism to democracy now facing Arafat's government.[153] The elections will provide the PA with greater legitimacy if the legislative council provides an effective forum for open political expression and in-

creased participation in the political process. If, conversely, the council is an inadequate mechanism to balance the power of the leadership, and opportunities for participation remained limited in the absence of improvements in living conditions, what once appeared to be unshakable Palestinian faith in Arafat will likely crumble.

Rapid population growth and intense agricultural activity in a region of scarce resources have combined with Israel's policies throughout the occupation to produce a potentially volatile political environment in Gaza. Today, the monumental task of achieving political stability is further complicated by the PA's authoritarian tendencies and Israeli policies of economic disengagement.

The interaction of severe supply, demand, and structural scarcities has constrained development and has contributed to the impoverishment of Gaza's population. Deteriorating economic and social conditions have produced collective grievance and violence against Israel and, more recently, against the PA. Solutions to the water crisis in Gaza will not in themselves solve the conflict. Nonetheless, steps toward the conservation and rehabilitation of the aquifer and the more equitable apportionment of the water that is available will be essential elements of a stable peace.

ENDNOTES

1. John Bulloch and Adel Darwish, *Water Wars: Coming Conflicts in the Middle East* (London: Victor Gollancz, 1993), 36.

2. Ibid.

3. See *The Jerusalem Post*, 24 September 1994, international edition, 24, and Serge Schmemann, "Bus Bomb Kills 5 in Jerusalem," *New York Times*, 22 August 1995, p. A6.

4. Joel Greenberg, "Palestinian 'Martyrs' Defiant and So Willing," New York Times, 25 January 1995, p. A6.

5. David Brooks and Stephen Lonergan, *Watershed: The Role of Fresh Water in the Israeli-Palestinian Conflict* (Ottawa: International Development Research Centre, 1994), 8–10.

6. Water Resources Action Program (WRAP), *Palestinian Water Resources* (Jerusalem: WRAP, 1994), 9.

7. Sara Roy, *The Gaza Strip: The Political Economy of De-Development* (Washington, D.C.: The Institute for Palestine Studies, 1995), 31–99.

8. Ibid., 110.

9. Conversely, there are no restrictions on Israeli imports to Gaza and the West Bank.

10. Roy, *The Gaza Strip: The Political Economy of De-Development*, 131.

11. Anita Vitullo, "Uprising in Gaza," *Middle East Report* 18, no. 3 (May–June 1988): 22.

12. Salim Tamari, "What the Uprising Means," *Middle East Report* 18, no. 3 (May–June 1988): 27.

13. Barry Rubin, *Revolution until Victory? The Politics and History of the PLO* (Cambridge, Mass.: Harvard University Press), 86.

14. Roy, *The Gaza Strip: The Political Economy of De-Development*, 303.

15. Ibid., 309-16.

16. Sara Roy, "The Seed of Chaos, and of Night: The Gaza Strip after the Agreement," *Journal of Palestine Studies* 23, no. 3 (spring 1994): 86.

17. These allegedly include house demolition, curfew, and assassinations by undercover Israeli security forces. Stanley Cohen, "Justice in Transition?" *Middle East Report* 25, no. 3/4 (May–August 1995): 4. Amnesty International reported in 1995 that human rights abuses in the form of illegal detentions and the torture of detainees (through beating, sleep deprivation, hooding, and binding in painful positions) continue under both the Israeli Defence Forces and the Palestinian Authority. Amnesty International, *Country Report: Israel and the Occupied Territories: Human Rights: A Year of Shattered Hopes* (AI index: MDE 15/07/95).

18. After implementation of the Accord, Raji Sourani of the Gaza Centre for Rights and Law estimated that there were some fifty-two checkpoints monitoring Palestinian movement within Gaza.

19. Derek Brown, "Disillusion Sours Hopes in Gaza," *Manchester Guardian Weekly*, 27 November 1994, 3. The pattern of settlement reflects the objectives of settlement policy following the Camp David accords of 1979: to create a strong Israeli presence which would make it difficult to form an independent Palestinian state in Gaza and to physically isolate Arab communities from one another, decreasing the possibility of unified autonomy. See Sara Roy, *The Gaza Strip: A Demographic, Economic, Social and Legal Survey* (Boulder, Colo.: Westview Press, 1986), 137.

20. Roy, "The Seed of Chaos," 86.

21. There are notable exceptions to this downward trend; a recent article profiled several Gaza Palestinians who have benefited greatly under autonomy. However, the examples chosen are all people with outside sources of financial support or with close ties to Arafat and Fatah's power elite. The article notes that "most Gazans still live in dire poverty." See Isabel Kershner, "Signs of Life in Gaza," *Jerusalem Report,* 13 July 1995.

22. Arafat's authority employs an estimated twenty thousand policemen — one for every fifty residents in the autonomous areas.

23. See Joel Greenberg, "Palestinian Martyrs Defiant and So Willing," A6.

24. *The Jerusalem Post*, 12 November 1994, international edition, 1.

25. Edward Said, *The Politics of Dispossession* (London: Chatto and Windus, 1994), 414.

26. Thomas Homer-Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security* 16, no. 2 (fall 1991): 85.

27. Thomas Homer-Dixon, "Environmental Scarcities and Violent Conflict: Evidence from Cases" *International Security* 19, no. 1 (summer 1994): 8–10.

28. Ibid., 10–11.

29. Homer-Dixon, "On the Threshold," 91.

30. Homer-Dixon, "Environmental Scarcities and Violent Conflict," 39.

31. Sandra Postel, *The Last Oasis: Facing Water Scarcity* (London: Earthscan Publications, 1992), 29.

32. Enviro-transpiration, or evapo-transpiration, is the loss of water an ecosystem experiences through evaporation from plant life and soil.

33. H. J. Bruins, A. Tuinhof, and R. Keller, *Water in the Gaza Strip* (Netherlands Ministry of Foreign Affairs, 1991), 6, and WRAP, *Palestinian Water Resources*, 4.

34. WRAP, *Palestinian Water Resources*, 4.

35. Jad Isaac, Applied Research Institute in Jerusalem, personal communication, 23 September 1995.

36. The Wadi Gaza, the area's only source of surface water, is impounded by Israel before it enters Gaza. Some piped water is supplied to Gaza from the Israeli Water Carrier (about 5 mcm, according to Jad Isaac of the Applied Research Institute in Jerusalem). However, "it is not clear whether Israel is actually supplying water to the Gaza Strip or is simply putting Gaza water into the Carrier." David Brooks and Stephen Lonergan, *Economic, Ecological and Geopolitical Dimensions of Water in Israel* (Victoria, British Columbia: Centre for Sustainable Regional Development, 1992), 77.

37. Bruins et. al., *Water in the Gaza Strip*, 8.

38. The salinity of the deeper aquifer is estimated to reach 60,000 ppm in some areas, almost double the salinity of sea water. Zaher Kuhail and Zaki Zoarob, *Potable Ground Water Crisis in the Gaza Strip* (UNRWA and the Palestinian Health Authority, 1994.)

39. See Natasha Beschorner, *Water and Instability in the Middle East* (London: International Institute for Strategic Studies, 1992), 14, and Bruins et. al., *Water in the Gaza Strip*, 9.

40. See A. A. Kubursi and H. A. Amery, "Water Scarcity in the Middle East: Misallocation or Real Shortages?" (paper presented at the conference "The Middle East Water Crisis: Creative Perspectives and Solutions," University of Waterloo, Waterloo, Ontario, 1992).

41. Roy, *The Gaza Strip: The Political Economy of De-Development*, 165.

42. Adnan Shqueir, "The Environment in the West Bank and Gaza Strip," *Palestine-Israel Journal* 2, no. 5 (Winter 1995): 90.

43. United Nations, Committee on the Exercise of the Unalienable Rights of the Palestinian People, *Water Resources of the Occupied Palestinian Territory* (New York: United Nations, 1992), 52–53.

44. Ibid., 53.

45. Brooks and Lonergan, *Watershed*, 92.

46. UN, *Water Resources of the Occupied Palestinian Territory*, 27.

47. Ibid., 31–32.

48. Taher Nassereddin, "Institutional Aspects of Joint Management of Aquifers by Israel and the Occupied Territories," in *Joint Management of Shared Aquifers; the First Workshop*, ed. Eran Feitelson and Marwan Haddad (Jerusalem: Palestine Consultancy Group and Harry Truman Institute, 1994), 60.

49. Brooks and Lonergan, *Watershed*, 134–5.

50. Ibid., 131.

51. Sharif Elmusa, "The Israeli-Palestinian Water Dispute Can be Resolved" *Palestine-Israel Journal*, no. 3 (summer 1994) 26.

52. Roy, *The Gaza Strip: The Political Economy of De-Development*, 15.

53. Brooks and Lonergan, *Watershed*, 40.

54. From the Statistical Abstract of Israel, 1992, cited in *Israel Water Study for the World Bank* (draft study, Ben Gurion University and Tahal Consulting Engineers, Beersheba, Israel, 1993), and WRAP, *Palestinian Water Resources*, 2.

55. WRAP, *Palestinian Water Resources*, 3, and Bruins et. al., *Water in the Gaza Strip*, 2.

56. When he visited Gaza in 1992, Said wrote: "Jabalya Camp is the most appalling place I have ever seen ... . There is no sewage system, the stench tears at your gut... . The statistics are nightmarish: the worst infant mortality rates, the worst unemployment, the lowest per capita income, the most days of curfew, the least medical services, and on and on." Said, *The Politics of Dispossession*, 195.

57. Peter Gleick, "Water and Conflict: Fresh Water Resources and National Security," *International Security* 18, no. 1 (summer 1993): 90.

58. World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 2 (Washington, DC: The World Bank, 1993), 35. In 1989, the Gaza Agriculture Department estimated that a total of 20,500 hectares were under cultivation (by both Palestinians and Israelis) in Gaza. Using these figures, the per capita figure for cultivated land for Israeli settlers in Gaza is 0.41–0.51 hectares, compared with 0.023–0.026 hectares for Palestinians.

59. World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 1 (Washington, D.C.: The World Bank, 1993), 10.

60. Patrice Claude, "Israeli Settlements on the Rise," *Manchester Guardian Weekly*, 16 October 1994, 15.

61. World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 4 (Washington, D.C.: The World Bank, 1993), 53.

62. Beschorner, *Water and Instability*, 14.

63. Nasseredden, "Institutional Aspects of Joint Management of Aquifers," 64, and Isaac, personal communication. While the majority of sources concur on these estimates for Israeli settlers, some sources suggest that settlers' withdrawals are considerably higher. One recent study estimated a total of thirty Israeli wells in Gaza in 1992, drawing approximately 20 mcm a year. Palestinian Committee for Peace and Afro-Asian Solidarity, "The Water Problem in Gaza and Proposed Solutions," *Development and Socio-Economic Progress*, no. 53 (1992).

64. Isaac, personal communication. "Consumption" refers to the amount of water *actually* withdrawn from the aquifer, as opposed to "sustainable supply," which refers to the amount which can *safely* be withdrawn withought exceeding renewable yield.

65. The definition of "excessive" in this case is extremely subjective. Thomas Naff (quoted in Brooks and Lonergan, *Watershed*, 88) notes that, compared with Canada and the United States, Middle Eastern nations, including Israel, are "remarkably efficient," but "not as efficient as the crisis and the scarcity requires them to be." The key issue regarding efficiency in this context is that settlers' consumption may be perceived as unreasonable relative to the strict limits placed on Palestinian consumption.

66. WRAP, *Palestinian Water Resources*, 13.

67. Ibid., 9.

68. Brooks and Lonergan, *Watershed*, 39.

69. David Brooks, *Summary Trip Report: Toronto, Israel, Gaza and Egypt* (Ottawa: Environment and Natural Resources Division, International Development Research Centre, December 1994), 4.

70. Official Israeli sources tend to blame the state of Gaza's water supply on the Egyptian administration which preceded them. Overexploitation almost certainly occurred prior to the annexation of Gaza in 1967. Under the Egyptian authorities, water consumption was not regulated, and the massive influx of refugees after 1948 put tremendous strain on the area's resources. Nonetheless, while the Israeli authority introduced regulations which may arguably have slowed down the rate of consumption, the resources continue to be overexploited. One commentator writes that "the water system in Gaza has been managed by Israel for twenty-seven years; it cannot wash its hands of the problem by blaming it, as it does on the Egyptian administration." Elmusa, "The Israeli-Palestinian Water Dispute," 20.

71. This figure represents the differential between estimates of safe renewable yield and actual consumption. Safe renewable yield is estimated at 60–65 mcm; consumption is estimated at 100–140 mcm. If we subtract a midpoint estimate of 120–125 mcm from the 60–65 mcm available, we are left with a deficit in the area of 60 mcm per year. Some sources, including the Israeli Defense Forces and the UN Conference on Trade and Development estimate this deficit to be much lower, approximately 30 mcm per year. The balance of evidence from all sources, however, appears to support the higher estimates cited here.

72. Brooks and Lonergan, *Economic, Ecological and Geopolitical Dimensions of Water in Israel*, 77.

73. Hisham Zarour, Jad Isaac, and Violet Qumsieh, "Hydrochemical Indicators of the Severe Water Crisis in the Gaza Strip," in *Final Report on the Project Water Resources in the West Bank and Gaza Strip: Current Situation and Future Prospects* (Jerusalem: Applied Research Institute in Jerusalem, 1994), 9.

74. Beschorner, *Water and Instability*, 15.

75. K. Assaf, N. al-Khatib, E. Kally, and H. Shuval, "Water in the Israeli-Arab Conflict," *Palestine-Israel Journal* 1, no. 3 (summer 1994): 14.

76. Anna Bellisari, "Public Health and the Water Crisis in the Occupied Palestinian Territories," *Journal of Palestine Studies* 23, no. 2 (winter 1994).

77. Zarour et. al., "Hydrochemical Indicators of the Severe Water Crisis," 13.

78. Highly saline water is regularly used for irrigation, with damage to crop yields already in evidence in many cases. Water sources in Gaza that fall below salinity levels of 600 ppm chloride are considered acceptable for irrigation; in Israel, levels between 200 and 300 ppm chloride are considered dangerous to citrus. Roy, *The Gaza Strip: The Political Economy of De-Development*, 163.

79. Zarour et.al., "Hydrochemical Indicators of the Severe Water Crisis," 20.

80. Roy, *The Gaza Strip: The Political Economy of De-development*, 164.

81. Sameer A. Abu-Eisheh, *Public Utilities in the West Bank and Gaza Strip* (New York: UN Conference on Trade and Development, 1994), 39.

82. Rafah's treatment capacity has been severely reduced since its construction in 1987 due to poor maintenance and excessive input of waste. See Abu-Eisheh, *Public Utilities in the West Bank and Gaza Strip*, 39. At the time of publication of these figures, expansion of the Rafah network was underway, and upgrading of its treatment facility was under consideration. The expansion of the Jabalya sewage network was also under consideration; See Ramzi Sansur, *Environment and Development Prospects in the West Bank and Gaza Strip* (New York: UN Conference on Trade and Development, 1995).

83. World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 6, (Washington, DC: The World Bank, 1993), 19.

84. Beschorner, *Water and Instability*, 15.

85. Kuhail and Zoarob, *Potable Ground Water Crisis*, 40.

86. Bellisari, "Public Health and the Water Crisis," 55–7, Kuhail and Zoarob, *Potable Ground Water Crisis*, 40.

87. There is one small desalinization plant operating on the Gaza coast, and several studies suggest that this is the best alternative for future water supply in Gaza. However, desalinization on a large enough scale to provide a viable alternative drinking-water source would involve prohibitive capital and operating costs given the current state of Gaza's economy. "Palestinians are skeptical of this mega-project approach, in part for fear that they will get stuck with expensive sources of supply, and in part because it diverts attention from the inequitable distribution of existing supplies." Brooks and Lonergan, *Watershed*, 136.

88. Bellisari, "Public Health and the Water Crisis," 61.

89. Kingston Frontenac and Lennox and Addington Health Unit, personal communication, 10 November 1995.

90. Bellisari, "Public Health and Water Crisis," 56.

91. Hypernatremia is a maldistribution of body water caused by a sodium imbalance. High concentrations of sodium in blood plasma draw water out of the red blood cells, causing them to collapse and consequently inhibiting gas exchange. The thirst mechanism is the body's primary defense against such an imbalance. Vulnerable individuals include infants or unconscious patients whose thirst mechanism is faulty or who cannot access water as needed. Vulnerability is also increased by high environmental temperatures, low humidity, and small size. See Lawrence Finberg, "Hypernatremia," in *Sodium: Its Biologic Significance* ed. Solomon Papper, (Boca Raton, Fla.: CRC Press Inc., 1982) 266–76.

92. National Research Council, *Drinking Water and Health* (Washington, D.C.: National Academy of Sciences, 1977), 403.

93. Kuhail and Zoarob, *Potable Ground Water Crisis*, 34–35.

94. National Research Council, *Drinking Water and Health* (Washington, D.C.: National Academy of Sciences, 1977), 403.

95. Ibid., 411–25, and Bellisari, "Public Health and the Water Crisis," 56–7. Spontaneous abortion may have impacts for animal husbandry, but the incidence and economic implications of this phenomenon in Gaza have not been examined.

96. "Skeletal fluorosis is manifested in brittle bones, increased rates of bone fractures and crippling deformities. Dental fluorosis...not health threatening itself, [is] indicative of enamel brittleness and potential damage to teeth." Bellisari, "Public Health and the Water Crisis," 56.

97. See Ramzi Sansur, S. Kuttab, and S. Abu al-Haj, *Evaluation of the Extent of Exposure of Farm Workers to Organiphosphate Pesticides in the Jordan Valley, West Bank* (Birzeit: Birzeit University Center for Environmental and Occupational Health Science, 1990).

98. Bellisari,"Public Health and the Water Crisis" 57–60.

99. While immediate testing of the water supply determined that the pollution was limited to one Gaza City neighborhood, Israel reacted by imposing a ban on all food imports from Gaza. *The Jerusalem Post*, 19 November 1994, international edition, 24.

100. Bellisari, "Public Health and the Water Crisis," 60.

101. Ibid., 57–60.

102. World Bank, *Developing the Occupied Territories*, vol. 1, 10. This expenditure is comparable to Israel's as a percentage; according to the Statistical Abstract of Israel for 1993, Israel's 1990 expenditure accounted for 7.8 percent of GNP. Of course, Israel's GNP is considerably greater than Gaza's in terms of dollar value. Seven percent of Gaza's GNP for 1990 ($825 million) amounts to approximately $58 million. Israel's health expenditure for 1990 amounted to approximately $3.8 billion.

103. Bellisari, "Public Health and the Water Crisis," 61.

104. For example, in January 1995 workers at a private clinic in Gaza City went on strike, demanding higher wages, social benefits, and the right to organize. The strike, which was not publicly acknowledged by the PA, was surprising, given massive unemployment in Gaza. See Amira Hass, "Gaza Workers and the Palestinian Authority," *Middle East Report* 25, no. 3/4 (May–August 1995): 25–6.

105. Roy, *The Gaza Strip: The Political Economy of De-Development*, 223.

106. World Bank, *Developing the Occupied Territories*, vol. 4, 85–86.

107. UN Committee on the Exercise of the Unalienable Rights of the Palestinian People, *Water Resources of the Occupied Palestinian Territory*, 60.

108. Anne Mosely Lesch, *Transition to Palestinian Self-Government* (Bloomington, Ind.: Indiana University Press, 1992), 104.

109. Roy, *The Gaza Strip: The Political Economy of De-Development*, 233.

110. The average yield per hectare for other fruit crops also declined slightly, from 4.2 tons/hectare in 1967/68 to 3.8 in 1985/86. David Kahan, *Agriculture and Water Resources in the West Bank and Gaza 1967-1987* (Boulder, Colorado: Westview Press, 1987), 43, 145.

111. Ibid., 38.

112. WRAP, *Palestinian Water Resources*, 16.

113. World Bank, *Developing the Occupied Territories*, vol. 4, 38-9.

114. Ibid., 5.

115. Ibid., 42–3.

116. UN, Water Resources of the Occupied Palestinian Territory, 48–9.

117. According to the World Bank, "similar cases" include Mauritius, with 33 percent industrial share of GDP for 1990, and Lesotho, with 30 percent. World Bank, *Developing the Occupied Territories: An Investment in Peace*, vol. 3 (Washington, D.C.: The World Bank, 1993), 27.

118. World Bank, *Developing the Occupied Territories*, vol. 4, 22.

119. A semiskilled construction worker can earn up to $71 a day, whereas in Gaza that same worker would earn only $14. Roy, "The Seed of Chaos," 93.

120. Ali Wihaidi, "The Economic Aspects of Joint Management of Shared Aquifers: A Palestinian Perspective," in *Joint Management of Shared Aquifers; the First Workshop*, eds. Eran Feitelson and Marwan Haddad (Jerusalem: Palestine Consultancy Group and Harry Truman Institute, 1994), 124.

121. Derek Brown, "Gaza Awards No Prizes for Peace," *Manchester Guardian Weekly*, 18 December 1994, 4. While GDP figures for 1994 are not available, 1992 figures provide a point of comparison. The Central Bureau of Statistics in Israel estimates the GDP of the Occupied Territories at between $2.4 and $2.5 billion for 1992. A $400 million loss would represent approximately 16 percent of GDP for 1992.

122. Roy, "The Seed of Chaos," 92.

123. Patrice Claude, "Year of 'Peace' Proves Disappointing for Palestinians," *Manchester Guardian Weekly*, 13 May 1995, 13.

124. Roy, "The Seed of Chaos," 90.

125. Claude, "Year of 'Peace'," 13.

126. Homer-Dixon, "Environmental Scarcities and Violent Conflict," 23–4.

127. Ibid., 26.

128. David Hirst, "Asking Arafat to Do the Unthinkable," *Manchester Guardian Weekly*, 11 December 1994, 3.

129. Mona Naim, interview with Mamoud Darwish, *Middle East Report* 25, no. 3/4 (May–August 1995): 18.

130. Dan Connell, "Palestine on the Edge" *Middle East Report* 25, no. 3/4 (May–August 1995): 8.

131. Cygielman, 127.

132. David Hirst, "Arafat's Foes Wait to Pounce on Their Prey," *Manchester Guardian Weekly*, 11 June 1995, 12.

133. The Israeli Right also came out in immediate opposition to the agreement, calling it a "black day in the history of Israel." Derek Brown, "Israel Agrees to Quit West Bank", *Manchester Guardian Weekly*, 1 October 1995, 1.

134. "Palestinians Feel the Stress of Change," *The Economist* 330, no. 4847 (22 January 1994): 43.

135. Claude, "Year of 'Peace,'" 13

136. *Foreign Reports*, 18 May 1995.

137. Brown, "Gaza Awards No Prizes for Peace," 4.

138. Brown, "Disillusion Sours Hopes in Gaza," 1.

139. Lisa Hajjar, "The Islamist Movements in the Occupied Territories: An Interview with Iyad Barghouti," *MERIP Reports* 23, no. 4 (July-August 1993): 10.

140. James Brooke and Elaine Sciolino, "U.S. Muslims Say Their Aid Pays for Charity, Not Terror" *New York Times*, 16 August 1995, pp. A1, A6.

141. Lisa Hajjar, "The Islamist Movements in the Territories,11.

142. Brooke and Sciolino, "U.S. Muslims Say Their Aid Pays for Charity, Not Terror," A1.

143. *Foreign Reports*, 18 May 1995.

144. Ahmad S. Khalidi, "Security in a Final Middle East Settlement: Some Components of Palestinian National Security," *International Affairs* 71, no. 1 (1995): 16.

145. Joel Greenberg, "Arabs Say Attacks Hurt Them Too," *New York Times*, 25 July 1995, p. A3.

146. In August 1995, the leader of Israel's Likud party, Binyamin Netanyahu, estimated that 170 Israelis have been killed in the two years since the Accord was signed; this figure reveals a marked increase from the 49 Israeli deaths in the year preceding the accord. See Serge Schmemann, "Bus Bombing Kills 5 in Jerusalem," *New York Times*, 22 August 1995, p. A6, and Cygielman, 10.

147. Said, *The Politics of Dispossession*, 195–6.

148. *The Jerusalem Post*, 12 November 1994, international edition, 1.

149. Shyam Bhatia, "Arafat's Torturers Shock Palestinians" *Manchester Guardian Weekly*, 24 September 1995, 13.

150. Roy, "The Seed of Chaos".

151. Cited in Greenberg, "Palestinian 'Martyrs' Defiant and So Willing," p. A6.

152. Serge Schmemann, "Big Vote Turnout for Palestinians," *New York Times*, 21 January 1996, p. A1.

153. Martin Cohn, "Warnings Amid the Euphoria," *Toronto Star*, 22 January 1996, p. A3.

About the Authors

Thomas Homer-Dixon
Thomas Homer-Dixon is Director of the Peace and Conflict Studies Program and Assistant Professor in the Department of Political Science at the University of Toronto. He is currently Principal Investigator of the project on Environmental Scarcity, State Capacity and Civil Violence, and Director of the Project on Environment, Population and Security. From 1990 to 1993, he was co-director of an international research project on Environmental Change and Acute Conflict organized by the Peace and Conflict Studies Program and the American Academy of Arts and Sciences. He received his doctorate in Political Science from MIT in 1989 and has written on a range of topics including arms control, environmental policy, and the philosophy of the social sciences.

Peter Gizewski
Peter Gizewski is a Senior Research Associate at the Canadian Centre for Global Security in Ottawa. Educated at the University of Toronto and Columbia University, where he was a MacArthur Fellow in Conflict, Peace and Security, Gizewski has published on a variety of subjects in international affairs and has taught international relations at Carleton University in Ottawa.

Philip Howard
Philip Howard is a Research Associate with the Project on Environment, Population and Security. He received his BA in Political Science from the University of Toronto and has completed a MSc in International Relations at the Development Studies Institute of the London School of Economics and Political Science.

Kimberley Kelly
Kimberley Kelly is a Research Associate with the Project on Environment, Population and Security. She received her BA in History from Queen's University and completed her MA in Conflict Analysis at the Normal Paterson School of International Affairs in Ottawa.

Valerie Percival
Valerie Percival is a Research Associate with the Project on Environment, Population, and Security. She received her BA in Peace and Conflict Studies from the University of Toronto and completed her MA in Conflict Analysis at the Norman Paterson School of International Affairs in Ottawa.

About the Editors

Thomas Wander
Thomas Wander is the former Director of the Program on Science and International Security of the American Association for the Advancement of Science. He received his BA in Government and Foreign Affairs from the University of Virginia and his doctorate in Political Science from Stanford University. He has been a research fellow with the Brookings Institution and has worked for the Congressional Research Service of the Library of Congress and for the office of Senator Dale Bumpers (D-AR).

Brian Smith
Brian Smith is a Project Coordinator with the Population and Sustainable Development Project and was formerly associated with the Program on Science and International Security, both of the American Association for the Advancement of Science. He received his BA in Political Science from the University of California at Berkeley and completed his MA in Government (International Relations) at Georgetown University.

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Valerie Percival and Thomas Homer-Dixon

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The Case of South Africa
Valerie Percival and Thomas Homer-Dixon

Environmental Scarcity and Violent Conflict:
The Case of Gaza
Kimberley Kelly and Thomas Homer-Dixon

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