Chapter Eleven

Population Growth

Linking to Economic Development, Resource Scarcity, and Food Security

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THE CONTINUED GROWTH of the human population is inevitable. Even if the demographic transition results in lower fertility and growth rates, population momentum will ensure a global population of 7.5 or 8 billion by 2025, bringing with it potentially significant societal and economic consequences. One question that remains, however, is whether a growing population has positive or negative implications for economic development, resource consumption, and food security, the topics of this chapter. The chapter begins by considering the work of Thomas Malthus, the eighteenth-century writer who first linked population and food resources. Following Malthus, the opposing approaches of Karl Marx and Friedrich Engels are introduced before examining links between population growth, economic development, resource scarcity, and food security. The chapter concludes with a discussion of the potential for conflict and instability. The "Methods, Measures, and Tools" section looks at the contributions of geographers to these areas of discussion, and the "Focus" section considers population growth and the potential for conflict over scarce resources.

THOMAS MALTHUS AND ''ESSAY ON THE PRINCIPLE OF POPULATION''

Demographers and others struggle with the question of whether the world can feed itself. Writing in the 1960s, Paul Ehrlich's *The Population Bomb* alerted the public to the population crisis, bringing with it a sense of urgency.[1] But, Ehrlich's warnings were not new, with the population-food (resource) debate having a long history, dating to Thomas Malthus's 1798 writing "Essay on the Principle of Population" and later writings by Karl Marx and Friedrich Engels. Writing during a period of poor harvests and food shortages, Malthus argued that food supply would increase in a linear fashion (1, 2, 3 . . .), while population would increase geometrically (2, 4, 8 . . .).[2] Ultimately, population would exceed agricultural output, unless population growth was somehow "checked." Historically, Malthus argued that so-called positive checks, including famine, plague, and war, decreased the population. Alternatively, population growth could be controlled through "preventative checks," with individuals imposing their own limits on reproduction. With Malthus holding out little hope that humanity would be able to control its sexual and reproductive needs, he forecast a dismal future of population decline and widespread poverty. In opposition to Malthus, Marx and Engels argued that people were poor because economies and societies were organized in such a way that they did not have the opportunity to be anything else but poor. Influenced by the social and economic conditions of Europe during the Industrial Revolution, they promoted social and political change (often through revolution) and believed that a just and equitable distribution of resources aided by technology would allow unlimited population growth.

SETTING THE STAGE: THE DEBATE AND CURRENT PERSPECTIVES

Malthus's dire predictions remain a focal point of the debate over population growth, and the ability to feed the world's population remains an important question.[3] Time has proven the basic perspectives of Malthusian and Marxian theories both right and wrong—our mere presence on this planet points to the failings of Malthus's core thesis. While fertility has been reduced largely through personal choices as standards of living rose and new ideas filtered through society, technology, the green revolution (the application of fertilizers and pesticides to increase crop yields), and biotechnology have allowed the world to accommodate a population far larger than Malthus ever saw possible. Agricultural production has grown tremendously, allowing per-capita food sup-

plies to increase despite continued population growth. Marx's position, on the other hand, seems vindicated in China. With a population in excess of 1.3 billion, China has proven that it can provide the basic needs of a large and rapidly growing population. At the same time, it has recognized that there are limits to growth, as it moved to reduce fertility through its one-child policy.

Even now, however, the Food and Agricultural Organization of the United Nations (UN FAO) estimates that over 920 million people were malnourished in 2007. While the majority of these were found in the developing world, many are also found in the developed world.[4] Millions more consume sufficient calories but fail to get the necessary proteins. Consequently, the world continues to grapple with the basic question of whether it can feed itself, both now and in the years to come. At the same time as agricultural production has increased, degradation of cropland through erosion, desertification, salinization, and urbanization have reduced the amount of land available for agriculture.[5] Created by poor farming practices, deforestation, and the use of ecologically marginal land, erosion can decrease average yields by reducing the soil's ability to retain moisture, by carrying away nutrients, and by degrading its physical qualities. Likewise, the salinization of crop land, whereby soils become increasingly salty because of saltwater infiltration, means the soil is unable to support agriculture. The expected impacts of climate change and the unequal distribution of food owing to distributional difficulties, conflicts, or politics within and among countries compound the problem.[6] With the world's population growing at a rate of 1.2 percent per year, and with over 130 million new souls each year requiring food and clothing and other resources, questions as to whether the earth can feed and sustain such a large population continue to be raised.[7]

Growing from the initial Malthusian/Marxian distinctions within the literature, three perspectives continue to underlie the current debate and influence public policy and commentary.[8] Pointing to growing carbon dioxide concentrations, the declining health of oceans, reductions in biodiversity, and degradation of land, *neo-Malthusians* argue that finite resources place strict limits on the growth of the human population and consumption.[9] If limits are exceeded, social breakdown occurs.[10] Recent food riots, caused by limited supplies and rapidly increasing costs, may be seen as a harbinger of future events, particularly as climate change redraws the agriculture map by reducing harvests.

Economic optimists, characterized by Julian Simon, see few limits to population growth and prosperity, provided the economic system and market mechanisms work correctly.[11] Following their reasoning, few societies face strict limits to growth or consumption, with optimists pointing to improvements in human health, life expectancy, and increasing food production to support their position. Finally, the *distributionist* viewpoint, which is favored by Marxists, focuses upon inequalities in the distribution of wealth and power within a society, and

argues that the poor distribution of resources, poverty, and inequality are the causes, not consequences, of population growth and resource depletion.

While the neo-Malthusian, economic optimist, and distributionist perspectives are still identifiable within the literature, the debate has essentially become two-sided, with neo-Malthusians on one side and optimists on the other. Each argument contains grains of truth, but neither conveys the entire story. So, what went wrong and where do we currently stand? First, returning to the neo-Malthusian perspective, empirical and anecdotal evidence has failed to support the assumption that population growth is limited by resource barriers. In very general terms, the human population has grown beyond most of the barriers that were assumed by neo-Malthusians. Over the past two centuries, agricultural technology and capital have increased agricultural productivity tremendously, allowing agricultural output to increase. Similarly, neo-Malthusians forecasted energy shortfalls, predicting that energy prices would grow over fivefold between 1973 (the first oil crisis) and 2000. While the 1990s and early-to-mid-2000s marked a period of relatively inexpensive energy, prices skyrocketed in 2007 and early 2008 amid concerns of declining reserves, the inability to find new reserves of oil and gas, and rapidly increasing use of energy within the developing world, especially China and India, only to fall with the onset of the recession.

Economic optimists have been much better in explaining the ability of the world to adapt to these apparent barriers. For them, the operation of economic institutions, and particularly free markets, is key. Properly functioning institutions can facilitate conservation, substitution, innovation, and global trade of goods. Induced innovation theory argues that changes in endowments of land or labor, for example, are reflected in market price signals.[12] Through their ability to generate profit, markets induce innovations and stimulate technological innovations that loosen or remove constraints to population growth, and price changes encourage people to tap new resources or to substitute. Ester Boserup, for example, showed that scarcity of cropland stimulates greater labor specialization, increased productivity, and changes in agricultural practices.[13] Likewise, new lands may be opened to agriculture, conservation may be stimulated, or resource substitution may promote the increased use of fertilizers to increase agricultural output. Similarly, scarcities of nonrenewable resources can be overcome through resource substitution, conservation, improved production efficiencies, and enhanced resource extraction technologies. Economic optimists also argue that population growth has a key advantage in that it produces more geniuses, providing society with the means to resolve scarcities. For Julian Simon, resources are only limited by humanity's ability to invent. Thus, innovation and technical fixes allow societies to move beyond constraints to growth. Resource scarcity and degradation are therefore not due to population growth or increased consumption, but are instead due to market failure.

Like the neo-Malthusian perspective, however, the optimist framework is also flawed. A larger population does not, for instance, necessarily mean more discoveries or more Einsteins, but perhaps only that more people make the same discovery. Instead, the supply of scientists and other thinkers is constrained by the level and accessibility of education, limited capital, poor and incompetent bureaucracies, corruption, and weak governments. The brain drain from developing countries and into the developed world may have an especially pernicious effect, as the developed world's immigration policies are tailored to accept the educated and/or those with skills. This institutionalized brain drain poses further and long-term difficulties for the developing world in terms of maintaining human capital and its ability to generate, retain, and utilize the highly educated members of its populations, which will be necessary to solve impending problems.

Moreover, optimists' arguments rest on the free operation of the market, an assumption that is stretched in many cases. Free markets are far from universal. Even in America, the quintessential free-market economy, regulations at various government levels (state, national, and international) interfere with its free operation. In the developing world, the markets frequently become murkier. Institutional limitations, including market failure associated with unclear common property rights and inappropriate pricing for scarce resources (i.e., undervalued resources) limit the creation or substitution of alternatives. In addition, institutional biases may be present within markets, such that there is a tendency for institutions to favor some actors over others, leading to the marginalization of segments of the population. Consequently, a key caveat of the optimist viewpoint is the *quality* of institutions, policies, and technologies that are inherent within a society. Together, these effects, which are in turn modified by cultural, historical, and ecological factors, have direct bearing upon the ability to respond to resource scarcity. If markets are not able to identify or effectively incorporate the costs of scarcity so that resources or goods are undervalued, resources will be exploited and solutions to scarcity will not be forthcoming. Relatedly, it is unlikely that population growth can promote increases in agricultural output that will keep pace with population growth rates in Africa and parts of Asia.

For the most part, the debate between these three groups has stopped here, a debate that Homer-Dixon characterizes as sterile and with relatively little advancement.[14] Science, however, has better revealed the complexity and interconnectivity of ecological systems, with implications for the population. In the past, the earth's environmental systems were regarded as stable and resilient to our tampering. Instead, there is mounting evidence drawn from observation of ocean currents, ozone depletion, and fish stocks that environmental systems are not stable given human actions. What was previously considered slow or

incremental changes to systems might be better described as nonlinear, with systems rapidly changing their character when some threshold is exceeded, making chaos and anarchy better descriptors of environmental systems.[15] There is increasing consensus that humanity—via population growth—is taxing the earth's resources to such a degree that complete ecosystems are disappearing. Global warming and the loss of biodiversity may, at some point, cascade to produce dramatic changes that humanity is ill-prepared to deal with.

LINKING TO ECONOMIC DEVELOPMENT, RESOURCE SCARCITY, AND FOOD SECURITY

In the coming decades, population growth, rising per-capita resource consumption, greater food demand, and inequalities in resource access guarantee that scarcities of renewable resources will become an issue. If population growth is taxing ecosystems, what is the prognosis for economic development, food security, and resources?

Population Growth and Economic Development

As the economies of the developing world, and particularly the poorest sub-Saharan countries, started to stagnate in the 1980s, social scientists scrambled to unearth the linkages between rapid growth and economic development.[16] After all, foreign investment and aid had poured into the developing world for years, and yet there was little to show for it. Instead, per-capita incomes had declined and an increasing proportion of the population lived in poverty. At the heart of the debate is the question of whether population growth favors economic development or hinders it, with the available data supporting a number of interpretations. On the surface, it is readily apparent that the richest countries are also those with slow population growth characterized by low rates of fertility and low mortality levels, while some of the poorest countries have high rates of population growth. The relationship is, however, not perfect, with oil-producing countries in the Middle East having high population growth (the fertility rate in Saudi Arabia and other Gulf states remains in excess of 2.1) as well as strong economic growth. The opposite is also true, with low population and low economic growth rates.

Muddying the waters are countering arguments that population growth promotes economic development. Recalling Boserup's argument (presented in chapter 9),[17] optimists have long asserted that population growth promotes economic development, assuming that it is a motivating force in the adaptation of societies, including the uptake or innovation of new technologies or economic reforms. The notion that population growth is in fact good for economic growth

is well grounded. In Europe and North America, population growth and declining mortality levels are thought to have stimulated economic development and the Industrial Revolution. However, a different perspective is seen in the developing world. Building upon a much lower standard of living than Europe or the Americas at similar stages in their economic development, and having far greater rates of population growth, this group of countries is not, on average, following the lead of developed countries. In fact, they are slipping further into economic crisis, enhanced by the HIV/AIDS epidemic and its social and economic ramifications along with recessionary pressures.

Although the linkage between population and economic development is complex, emerging evidence reinforces the *negative* linkage between rapid population growth and economic development. The US National Research Council reinforced population's negative effect on economic growth, concluding that rapid population growth damages economic growth.[18] For economic development to occur, capital must be invested in such things as education, health, or infrastructure, a difficult proposition in much of the world, where poverty impedes the ability for governments and individuals to invest. For economies to grow, the level of capital investment must also grow, with higher rates of population growth necessitating higher rates of capital investment. Following a Malthusian line of reasoning, if the population growth rate exceeds the investment rate, countries will be trapped in poverty, unable to invest in themselves and provide the needed infrastructure. Although economic growth would occur under these situations, population growth is so high that economic growth is distributed throughout a larger population, meaning that individuals will receive a smaller proportional share.

This negative linkage can be viewed through a number of relationships linking rapid population growth and high fertility to economic growth.[19] First, rapid population growth tends to dampen the growth of per-capita GDP, a relationship that first appeared in the 1980s and appears strongest among the poorest countries.[20] The growth of GDP can be limited by high young dependency rates, reflective of high fertility rates. With a young population profile, the attendant costs associated with health and education for children are high, reducing household savings and increasing government expenditures. In turn, the growth of GDP is reduced, with the investment providing only long-term economic payoffs.[21] The impact on economic growth is also seen in the creation of new jobs. In countries with rapid population growth, labor markets are frequently unable to provide sufficient employment opportunities for the young, leading to underemployment or unemployment. This negative relationship has continued, ensuring that inequalities between the developed and developing world remain and providing little hope for their rapid amelioration.

Second, population growth and high fertility tend to aggravate poverty and

promote its institutionalization from one generation to the next. In particular, population growth will likely reduce or slow wage growth among the least skilled and lowest-income groups. India, for example, has accommodated high population growth, but economic development policies have favored or improved the status of only 15 to 20 percent of the population. The poor in India have paid the highest price. Much of India's public education system, which is predominantly attended by lower socioeconomic classes, is underfunded and inadequate. The poor are progressively marginalized and increasingly unable to participate in the economy because of poor health, lack of nutrition, or illiteracy.[22] In addition, a cadre of low-skilled, low-wage workers may slow the adoption of more efficient technologies.

Third, high fertility inhibits household savings, forcing household expenditure on basic goods and services for a larger number of people while savings or expenditures upon education are postponed or neglected. Conversely, declining population growth and fewer children mean that households are able to invest in education and place more of their earnings in savings, a necessary condition for economic growth. The economic literature has, for example, largely attributed the growth of Asian economies such as South Korea during the 1980s to increased household saving rates as fertility dropped and incomes grew.[23] As families saved more, domestic savings increased and were invested both within the country and exported elsewhere.

Fourth, following Easterlin's reasoning, higher fertility rates mean that parents have less to invest in each child than those with smaller families. Similarly, children from larger families have less schooling on average than their counterparts from smaller families. In countries with rapid population growth, there is increased pressure placed on education and health care, requiring increased financial commitments. Unless rapid growth of government revenues is also occurring or governments are willing to shift spending priorities, expenditures on education and health are depressed.[24] Again, evidence in support of this can be drawn from Asia. In South Korea, decreasing fertility levels and young dependency rates meant that the government was able to quadruple real per-student educational expenditure between 1970 and 1989, even as it spent an approximately equivalent proportion of its national budget on education. If South Korea's share of school-aged children had grown as fast as Kenya's during the same period, it would have needed to spend more than double what it did.[25]

Finally, population growth threatens resources by placing increased pressure upon them, whether resource use is associated with increased per-capita consumption (i.e., through increasing incomes and demand) or through increasing demand generated by a growing population, even if per-capita demand remains the same. Forest products, fisheries, cropland, and freshwater resources are all vulnerable to human-induced pressures.

Rapid population growth and high fertility seemingly have the greatest negative impact in the poorest countries where national institutions are weak.[26] In these cases, population growth reinforces a downward economic spiral, reflective of several sub-Saharan countries with high fertility rates and lower average per-capita incomes today than two decades ago.[27] Poorly developed markets and/or ineffectual government programs and leadership fail to protect, invest in, or build the basic infrastructure that is needed. Without strong institutions to assist national programs associated with education, fertility and family planning, or infrastructure development, rapid population growth will decrease the supply of ingenuity, exacerbating resource scarcity and environmental degradation. In turn, failure to invest in infrastructure and the degradation of assets can cripple institutions and markets. Moreover, governments in developing countries often lack the financial or political ability to invest in institutions that will promote labor force development.

Population Growth and Resource Scarcity

The debate over the relationship between population growth and resources parallels that over population and economic development, pitting neo-Malthusians against economic optimists, with both groups claiming evidence to support their position. One point seems intuitive: the collective impact of 6.7 billion people on the Earth's ecosystems, measured through resource use, consumption, or pollution, is tremendous. Whether the current rate of resource consumption is sustainable is unknown, but it is suspected that current consumption patterns and human impacts are not sustainable over the long run. Already, many regions are faced with scarcities of cropland, water, and forests.

In his 1999 book, Homer-Dixon identified three sources of resource scarcity: supply-induced, demand-induced, and structural scarcity. Supply-induced scarcities occur when resources are depleted in quantity or have become degraded, perhaps through overexploitation or pollution. Demand-induced scarcity occurs when population growth and changes in consumption patterns boost the demand for a resource. Such scarcities occur only when a resource is rivalrous, meaning that its use by one economic actor reduces its availability for others, with examples including fisheries, water, or forests. Structural scarcity occurs when there is an imbalance in the distribution of the resource or in power and wealth within a society, such that certain groups get a proportionately larger share of the resource. If a resource is excludable (i.e., cropland), such that its use can be restricted or blocked through property rights or other institutions, some groups may be prevented from accessing the resource.

Not surprisingly, population growth is a key factor driving all three types of resource scarcity. Rather than operating independently, each of these sources

of scarcity may interact and reinforce one another, either through *resource capture* or *ecological marginalization*.[28] Resource capture occurs when a scarce resource forces actors (i.e., governments or ethnic groups) to assert control over resources through legislation or other means. Poverty, desperation, and a lack of environmental knowledge to protect resources magnify the problem.

Whether the discussion is global or national, it is not just a question of feeding a large population, but also the tasks of providing health care, education, and infrastructure while finding employment and increasing the standard of living over the longer term in a sustainable fashion. Population growth also influences such diverse issues as increased energy consumption, global warming, ozone depletion, deforestation, loss of cropland, loss of biodiversity, and shrinking freshwater resources. Together, the requirements of a growing population may only be met by extracting a huge toll upon limited resources, which may only cripple future sustainability, a situation that is compounded by unequal access to resources and the marginalization of populations.

Population Growth and Food Security

Resource scarcity is closely linked with food security. It is questionable whether some countries, such as China, Egypt, and India, have the resources and economic ability to sustain their populations indefinitely, even if population growth was to cease immediately. Writing for the World Watch Institute in 1995, Lester Brown questioned the ability of China to feed itself in the coming decades.[29] Drawing from the experiences of other Asian countries, Brown forecasted a combination of rising standards of living and movement "up the food chain" from staples to more complex diets including animal proteins. Ultimately, increased food consumption, loss of cropland to urbanization, and declining water resources, among other factors, would mean that China would not be able to feed itself. The inability to domestically grow a sufficient food supply would force China to turn to world markets to purchase the necessary grains and other foodstuffs. The problem lies in its expected demand for grains, which Brown projected to exceed total world output, driving up prices globally and weakening the ability of smaller, poorer countries to purchase their requirements. Climate change may exacerbate food-supply issues by impacting crop production, food security and availability, and crop distribution. With the shifting precipitation patterns and decreased crop yields that are expected with climate change, many developing countries will become increasingly dependent on food imports. At the same time, pressure to cultivate marginal land or use unsustainable cultivation practices may lead to increased land degradation.

Food and resource scarcity is particularly problematic in the developing world, which is heavily reliant upon local resources for day-to-day survival. Already, many developing countries face a bleak future resulting from large-

scale demographic, environmental, economic, and societal stresses.[30] The links between food supply and demand are complex,[31] with food supply affected by land and water constraints, lack of investment in agriculture, trade, weather, and lack of access to fertilizer and irrigation. Food demand, on the other hand, is affected by such factors as rising energy prices, population growth, globalization of food markets, changing diets, and the use of cropland for biofuel production. Beginning in 2000, food prices started to rise sharply, with some of the greatest price increases associated with the food crisis of 2007–2008, which saw the price of wheat and corn triple between 2005 and 2008, while rice rose fivefold.[32] Price increases reflected poor crops in parts of the developing world, the rapid increase in food demand, and a decline in the food supply:[33] fuel prices increased, droughts reduced harvests, and cropland was shifted from food to biofuel production. The result: not enough food, with the world's poorest being the most vulnerable. The UN FAO estimated that the escalating food prices increased the number of malnourished by 75 million,[34] with food riots in Haiti, Indonesia, Ivory Coast, Thailand, and other countries.[35] The world recession of 2009 further destabilized countries, with the United Nations estimating that twenty-seven nations were approaching instability with the loss of food security. Food aid from donor countries collapsed as the recession took hold, food prices remained high despite declines in fuel costs, investment in agriculture plummeted, and people in the developing world suddenly had less money to purchase food with as they too lost jobs or remittances from family members working in other countries.

Two broad processes pose concerns for global food security in the future. First, climate change could further jeopardize food crops and security as precipitation patterns are shifted and temperatures increase. The result, if not corrected, could be spreading violence and anarchy, perhaps making the riots of 2008 the opening paragraph for future unrest in the developing world. On its own, climate change is estimated to increase the number of malnourished between 40 and 170 million globally. Even slight increases in temperature are expected to reduce crop yields, particularly in tropical latitudes, including sub-Saharan Africa.[36] Agricultural land may be lost due to decreased precipitation and desertification, reducing food production. Compounding the problem are the generally lower intensity of agriculture and reduced availability of capital for agriculture in the developed world and limited funds to import increasingly expensive staple foods. In Africa, climate change could depress grain production by 2 to 3 percent by 2030,[37] while the UN FAO estimates that India could lose 18 percent of its total grain production. Poor and small-scale subsistence farmers will be especially vulnerable to income or food supply disruptions due to climate change given their limited capacity to adapt to changing climate. Consequently, countries will become more dependent on imported food sup-

plies and/or be forced to cultivate marginal land or use unsustainable cultivation practices, increasing the likelihood of land degradation.

Second, population growth means more mouths to feed. World population is expected to reach seven billion by 2012, and the demand for food is expected to double by 2020, with about 20 percent of this increase attributed to population growth.[38] Compounding the problem are issues of land fragmentation (smaller farms that are not sustainable); the use of marginal lands for agricultural production in many areas of the developing world; increased urbanization, which is associated with the loss of agricultural lands; increased energy costs, which increase the cost of fertilizers and pesticides as well as increasing the demand for biofuels, which results in land shifted from agricultural production to biofuel production; and changes in food consumption practices, including the addition of more meat to traditional diets.

CONCLUSION: THE POTENTIAL FOR CONFLICT?

In his 1994 article "The Coming Anarchy," journalist Robert Kaplan painted a dire prediction of the world's future.[39] Robbed of their economic power by globalization, poor leadership, and environmental decay, peripheral states would disintegrate into smaller units defined by ethnicity or culture and ruled by warlords and private armies. Kaplan held out Africa and its seemingly endless list of war-ravaged countries as symbolizing the decay of the current world order, having already succumbed to environmental and demographic distress, leading to the breakdown of traditional civil government. Kaplan argued that violence and conflict have become the norm in many of these locations.

While perhaps sensationalized, the basic question within Kaplan's article is whether resource scarcity can prompt conflict. A short answer would be yes, with conflict potentially arising from scarcities and disputes over cropland, water, forests, or other resources. As we have seen, these are underlain by population issues. Resource scarcity may lead to harmful social effects, including constrained economic or agricultural production, migration, segmentation of society along ethnic or religious lines, and the disintegration of societal institutions, all of which can lead to conflict.[40] Effects are often causally linked, oftentimes with some feedback measure that tends to reinforce the initial negative consequences, such that resource capture arising from scarcity may induce further environmental degradation or greater scarcity of the resource.

Although the effects of resource scarcity are still poorly understood, there is a strong possibility and a growing body of evidence that they will affect social stability and ultimately underlie conflict, such as the food riots of 2008. While

this is an intuitive assumption, questions remain as to what the exact relationship is and how it works. How, for example, does resource scarcity contribute to conflict? Most likely, it is through a complex set of interactions. Given that population growth will continue in the coming decades, and that scarcities of renewable resources caused by climate change, depletion, or degradation are relatively certain to occur, it is reasonable to assume that supply, demand, or structural scarcities could result in negative social effects, including reduced agricultural and economic output, migration and displacement, social segmentation, and institutional disruption. In turn, each of these could independently or collaboratively induce conflict.[41] In addition, resource scarcity can produce resource capture when actors seek to change the distribution of resources in their favor owing to a decline in the quality or quantity of a resource, leading to the ecological marginalization of weak groups. Both processes further environmental degradation, reinforce poverty, and increase the potential for conflict as groups seek to control resources or address imbalances in the distribution of resources.

The not-so-trivial question that both neo-Malthusians and economic optimists consider is whether the world can provide sufficient food, water, and other resources in the face of continuing population growth. Intuitively, we can find relationships between population growth, resource use, and environmental scarcity. For example, in regions where population growth is high, resources such as food, fuel, and water are often scarce, and the risk of environmental degradation is increased. But this is not a perfect relationship. In fact, understanding the linkages between population growth, environment, and resources is sketchy at best.[42] However, even if the most alarmist predictions are discounted, there is consensus that population growth slows economic growth and multiplies the damage created by other problems. That is, it is difficult not to conclude that population growth exacerbates land degradation: resource depletion promotes violence and conflict and places pressure upon institutions and governments. This is not to say that population growth is solely responsible for these problems. Environmental degradation, for example, is not just a function of the number of people, but how much and what they consume and how that consumption damages the environment. Nevertheless, population growth is an issue.

What of the broader resource and economic issues? Can the same logic be extended to include the impact of a growing population and increasing consumption upon other resources? Are current levels of resource consumption sustainable? The emerging consensus is that rapid population growth and high young dependency ratios relative to the size of the labor force reduce economic growth by increasing poverty and underemployment, weakening investment in human and physical assets (i.e., education, institutions, family planning,

household savings), and decreasing and degrading resources. Worse, rapid population growth and poor economic growth appear to be self-reinforcing, making it exceedingly difficult for countries to pull themselves out of this downward spiral, given the lack of well-developed institutions in many of the poorest countries.

Finally, the developed world is not immune to the consequences of environmental scarcity, feeling the impact of induced migration from developing countries. Internal conflict or the disintegration of most any country would most likely produce large flows of displaced persons and migrants, potentially reinforcing environmental degradation and social segmentation. Much of the migration from rural Mexico or Haiti into the United States, Chinese immigration into North America, and migrations from North Africa into Europe can be attributed to resource scarcity in a broadly defined way. Many of these undocumented migrants are poor who are leaving behind economically or ecologically marginal areas. With few options in their homelands, they seek a new future elsewhere. For receiving countries, immigration alters the population composition of the country, and immigrants are most likely settling in urban areas. As discussed in chapter 7, governments are forced to react, limiting immigration or quelling anti-immigrant sentiments within the larger society. Similarly, the disintegration or political/economic destabilization of states would surely have implications for regional security and trade patterns, and ultimately the developed world. Countries and their governments may be precluded from effectively negotiating agreements, or may be completely excluded by the international community.

FOCUS: RESOURCE CONFLICT

In the past, national and international conflicts have frequently been predicated upon the territorial ambitions of governments and the concept of a nation-state.[1] In the twenty-first century, the nature of conflict is likely to represent the new realities of resource scarcity and population growth, a potential that is greatest where local institutions are weak, population growth is the greatest, and resources are the scarcest. Consequently, the number of conflicts linked to resource scarcity is likely to increase in the coming decades, with the developing world being at greatest risk. Having greater dependency upon local resources for economic and agricultural production and prosperity, frequently lacking the financial resources to buffer themselves from the negative effects of resource scarcity, and having fragile institutions, they are also less able to adapt.

If the emergence of resource scarcity potentially leads to conflict, what types of conflict are most likely to occur? Homer-Dixon[2] convincingly argued that population or resource scarcity issues will increasingly un-

derlie conflicts in the coming years. In particular, he argued that disputes directly related to environmental degradation, ethnic conflicts due to migration and population displacement caused by environmental scarcities, and civil disorder and conflict caused by environmental scarcity that affects economic productivity and livelihood would be the most common in the developing world, where environmental scarcities would interact with and be contextualized by existing economic, cultural, political, or social factors, perhaps even reinforcing conflict and the decline of institutions.

RESOURCES AND CONFLICT

In their simplest case, resource conflicts are easily understood within the traditional paradigms of territory, power, and interstate relations, as states or other actors have commonly moved to secure nonrenewable resources such as oil. Conflicts related to oil include civil wars in Sudan and Angola and Iraq's invasion of Kuwait in 1990, which was partially based upon Iraq's desire to control major oil fields in the region.[3] With projections that known world oil supplies are likely to peak within the next twenty years, oil is likely to remain the "prize," a resource that is fought over in the coming years.[4]

Resource capture, whereby the decreasing quality or quantity of a resource interacts with population growth and increasing consumption and encourages groups to control a resource through trade or military conquest, can also be extended to renewable resources (i.e., resources that can be harvested and used up to some threshold without threatening their long-term viability) such as cropland, forests, or fresh water.[5] Scarcities of some of these resources are increasing rapidly in places, leading to their potential seizure through military or other means, marginalizing groups and increasing resource scarcity or degradation.

Water may ultimately prove to be a key resource, critical for the survival of individuals as well as the state. While water is a renewable resource, its increasing scarcity, reduced not only through consumption but degraded through pollution and salinization and further compromised by climate change, threatens the livelihood and security of states, with the shortage defined as "water vulnerability."[6] But rather than directly causing conflict, water scarcity tends to limit economic development, promote resource capture, or lead to social segmentation, which in turn produces violence. Moreover, its transnational character, with rivers or underground aquifers crossing state borders, means that the use and actions of one country affect neighboring states. Various observers, including the United Nations,[7] have not missed the strategic importance of water. In 1995, the World Bank cautioned that wars in the coming century would be fought over water,[8] a statement that echoed a much earlier prediction by Jordan's King Hussein, who declared that only water issues could incite a war between Jordan and Israel. Years earlier, Egypt's former president Anwar Sadat indicated that he was prepared to use force if Ethiopia blocked or reduced Egypt's access to waters from the Nile, while Ethiopia chided Egypt for placing water from the Nile on the negotiating table during peace negotiations between Egypt and Israel in 1976.[9] At other times, water in the Middle East has been described as being more valuable than the oil pumped out of the ground. Still, conflict over scarce water resources is only valid in a limited number of circumstances where the downstream country is dependent on the water and the upstream country

restricts its flow. Similarly, conflict is only likely to occur when the water supply is essentially finite (i.e., limited renewal), as it is in many Middle East countries, so that an increasing population means a decreasing per capita supply.

Despite the constraints of downstream and upstream geography, there are multiple examples of water's ability to induce conflict. When water resources and the relationship between states are contextualized by differences in religion and historical animosities, such as between Israel and its Arab neighbors or between Turkey and Syria, the potential for conflict between states is further increased (figure 11F.1). Water resources may have promoted Israel's military campaigns in south Lebanon. When Israel moved to create a security zone to protect its northern boundary, its invasion of southern Lebanon in 1982 placed the waters of the Litani River within Israel's borders for the duration of the occupation, echoing repeated calls dating from as early as 1919 for the Litani River to form the northern border of the Jewish state.[10] Likewise, water has colored relations between Egypt, which is dependent upon the Nile River for fresh water, and its upstream neighbor Ethiopia. Relations between Turkey, Syria, and Iraq have also been strained over control and access to the Euphrates and Tigris rivers, with Turkey's Great Anatolia Project, a massive complex of dams and irrigation systems in east Turkey, promising to significantly reduce the flow of the Euphrates when it is completed. What water does reach Syria will be contaminated with runoff laden with fertilizer, pesticides, and salts. Syria is already short of water, and its population growth (2.5 percent, doubling in approximately thirty years) complicates its need for water. Although Syria is weak relative to Turkey and therefore does not pose a likely military threat as a provoked downstream neighbor, these two countries have already exchanged threats over water resources. Syria has also allegedly sanctioned Kurdish guerillas fighting the Turkish government over control of eastern Turkey for the creation of a Kurdish state, the same area as the Great Anatolia Project.[11]

Elsewhere, water has been linked to conflict. In Africa, South Africa's support of a coup in Lesotho in 1986 has been linked to its desire to divert water out of Lesotho and into South Africa.[12] Also in Africa, the Senegal, Zambezi, and Niger rivers all flow through several countries, with the Senegal River the focus of conflict between Mauritania and Senegal. In the Lake Chad basin in North Africa, geophysicists have warned of the shrinkage of Lake Chad.[13] Since the 1960s, it has shrunk by 95 percent, with irrigation and drought the major causes. The loss of water in a region with a growing population of over 750,000, even as the diminished water supply threatens fish stocks and crops, could result in increased tensions between the four countries (Nigeria, Niger, Cameroon, and Chad) that utilize the lake's water. Finally, there are disputes over water rights in the former Soviet republics of Uzbekistan, Turkmenistan, Kazakhstan, Tajikistan, and Kyrgyzstan, which compete for the limited resources of the Amu and Syr rivers. Under the former Soviet Union, the government dammed and diverted the rivers, turning what was literally an arid desert into a huge cotton-growing region.[14] Since the end of the Soviet Union, competing rivalries between the five countries, capitalism, and waste have all but destroyed the system, leading to water shortages and increasing salinization of cropland, while the Aral Sea is literally choked of waters that might replenish it.

CONCLUSIONS

The combined effects of population growth and resulting resource scarcity may mean

Figure 11F.1 Israel and Neighboring States.

Source: Maps.com.

that the world will witness an increase in conflict at various spatial scales, which may be underlain by issues pertaining to resource scarcity and population growth. Moreover, the speed and regularity with which resource conflicts will occur will increase in the future as resources become increasingly scarce and as populations grow. Developing countries dependent upon local resources but lacking the ability to mitigate scarcities are likely to be affected sooner, facing more regular, more

complex, and more severe problems arising from environmental scarcities. If they do not have the abilities, measured by ingenuity or finances, to overcome these problems, scarcities can overwhelm the country and further erode its ability to overcome the scarcity.

While large-scale conflict is possible, environmental scarcity will generate chronic, diffuse violence, with conflicts increasingly at local or subnational scales. As a consequence of globalization, governments may be helpless in the face of environmental stress, escalating poverty and disease and social friction. For peripheral countries, which are already faced with few economic prospects, population growth, disease, and environmental stress, the future is bleak, and conflict will undoubtedly arise between groups over access to scarce resources. Weakened by globalization that has tended to bypass many of the poorest countries and the increased power of warlords, crime gangs, drug cartels, or guerrilla groups, future conflict may be "borderless," failing to conform to existing notions of interstate or intrastate conflict, with influence exerted not by a state, but instead by ethnic groups or clans.[15]

METHODS, MEASURES, AND TOOLS: WHAT HAVE GEOGRAPHERS CONTRIBUTED TO THE DEBATE?

Throughout the book, geography and the geographical perspective have underlain the discussion. In many instances, geographers and the geographical perspective have made important contributions in areas, including market location and analysis, medical/health geography, land-use planning, environmental issues, and analytical techniques commonly used by geographers. The contributions of population geographers have been noted in the introduction and throughout the book, particularly those contributions related to population mobility, while geographers have spent less time working with mortality and fertility. Geographers have also contributed to debates, including climate change (i.e., through the Intergovernmental Panel on Climate Change [IPCC]), water and other resources, food supply and security, international relations, and terrorism. While far from exhaustive, the following represents a sampling of the contributions made by geographers that relate to themes within this book.[1]

POLITICAL GEOGRAPHY AND INTERNATIONAL RELATIONS

Harm de Blij argues in his book *Why Geography Matters: Three Challenges Facing America*[2] that "geographic literacy is a matter of national security" and that

> Geographic knowledge constitutes a serious, perhaps critical, disadvantage in an increasingly competitive world. Geographic insights can be crucial in addressing geopolitical problems; they are needed also in decision making in spheres ranging from the cultural to economic.[3]

It's not surprising that geographers have long engaged such debates, given the inherently geographical nature of many of the

problems identified by de Blij and others. Both Poulson (1995)[4] and Glassner (1996)[5] provide an overview of political geography and international relations. Some twenty geographers explored various issues, including socialism, capitalism, and problems of population growth and international migration, in *The Geographies of Global Change*.[6] Other geographers, including Cutter, Richardson, and Wilbanks (2003),[7] have explored the links between geography and terrorism, using geographical tools to prevent and prepare for terrorist attacks while also considering how terrorists mobilize across space and why terrorism develops in particular locations. Stump (2000)[8] explored religious fundamentalism as a phenomenon that has spread rapidly in recent decades, along with the social and cultural implications for societies.

POPULATION HEALTH AND HEALTH GEOGRAPHY

Population health has not escaped the interest of geographers, with work by Gatrell and Elliott[9] and Meade et al.[10] Spatial diffusion of disease is closely linked with epidemiology and has formed a cornerstone of work in this area. Later, the role of place was increasingly recognized. Work by Kearns and Gesler (1998),[11] for example, developed the importance of place as a determinant of health, an idea that now underpins much of the work in the subdiscipline, including work by Williams and Eyles.[12] Likewise, geographers, including authors such as Gould (1993)[13] and Kalipeni and Oppong (1996),[14] have made important contributions to the HIV/AIDS discussion and the understanding of the patterns of disease transmission. Advances in visualization tools and methods, particularly GIS and spatial analysis, have contributed to this area, but the use of qualitative methods demonstrates the nuances of health geographies.[15]

RESOURCE ISSUES

Resource production and use raises multiple issues, including those related to conflict, sustainability, location, and climate change. As such, research in this area often cuts across geographical dimensions, incorporating physical, human, and environmental branches of the field. A large body of geographical work has built around land and resource use, including water resources, which intersect both physical and human geography. Insight and solutions require knowledge of the hydrologic cycle as well as the relationship between human impacts and the cycle. Amery and Wolf (2000), for instance, have discussed Middle East water resources and links to conflict.[16] Discussion of water resources at other geographic scales, including within the United States, is also of importance and interest, including water laws and groundwater depletion, water rights, and water management, particularly in the Great Plains.[17] The relationship between population growth and energy use, and its relationship to global climate change, has also attracted the attention of geographers, including that of physical geographers and earth scientists.

AGRICULTURE AND FOOD SUPPLY

A dominating issue throughout the geographic (and other) literature is that of the relationship between population and food supply. Food production might continue to grow faster than the population, and the world will likely be able to feed a much larger population, but the question is how

many can the world really feed? It may yet have difficulty feeding its population. Not surprisingly, much of the recent geographical work has also focused on population growth and transformation of agriculture, land tenure, resource conflict, and environmental issues. Turner et al. (1993),[18] for instance, explored the relationship between population growth and agricultural transformation in Africa, concluding that while population growth has spurred change, it also reflects differences in the environment, land tenure systems, technology, and politics. Another geographer, Vaclav Smil, has explored the ability to feed the world's population. Based on data from the mid-1990s, he concluded that there was more than enough food to feed the world's population based on a daily caloric intake equivalent to that of the average North American. However, Smil also cautioned that the carrying capacity of the earth had already been exceeded, if all six billion were fed a diet similar to that of an average American, particularly given the emphasis on meat proteins in the average American diet.[19] Fortunately, many in the developed world tend to be overfed, the Western diet is wasteful, and there are global inefficiencies in the way food is produced, distributed, and consumed. By correcting these inefficiencies and altering the diet, for example by decreasing or removing animal proteins (which tend to be less efficient users of agricultural resources), Smil estimated that a population of 8.4 billion could be supported, with no new land required for cultivation and no new technologies that dramatically increase agricultural output. Increasing the daily caloric intake would reduce the final population size the earth could support.

THEORY

A discussion of the contributions to the field of population geography would not be complete without recognizing the role of theory. For much of its history, population geography has been rooted in positivistic frameworks and emphasized data and methods, reflecting the impact of formal demography on the field. Empirical work and data have dominated theory formation, meaning that research, and consequently theoretical advances, has tended to concentrate in data-rich areas, with the implication that theory formation has been disadvantaged.

Recent discussions have, however, attempted to move the theoretical basis of population geography, so that it has, for example, engaged social geography, as witnessed by authors including Graham and Bailey, Halfacree, and Boyle.[20] Critical population geography, such as Tyner's 2009 "War, Violence, and Population: Making the Body Count,"[21] will also influence the field of population geography and influence future work. Moreover, the book connects fertility, migration, and mortality with war and conflict.