

WORLD•WATCH

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Population AND ITS DISCONTENTS

One of 12 features in this special issue

Excerpted from the September/October 2004 WORLD WATCH magazine

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Not Tonight, Sweetie; No Energy

A Neo-Malthusian Looks at Fossil Fuels and Fertility

The “fertility opportunity hypothesis” holds that parents want more children when they perceive forthcoming opportunities for a better life, but have fewer children if they anticipate hard times ahead. Perceptions of a coming global oil scarcity could result in population growing less than the UN expects.

The Reverend Thomas Malthus (1766–1834) was notorious for the view that “positive checks”—meaning poverty, famine, and premature mortality—are the only means of keeping population size in balance with resources. But his second edition of *An Essay on the Principle of Population* is far from pessimistic: it develops the idea that “moral restraint” (encompassing social rules as well as personal decisions) often depresses the fertility rate, thus slowing or stopping population growth before calamities occur.

Worldwide, the dynamics of self-restraint are causing fertility rates to fall much more rapidly than generally anticipated, vindicating Malthus’s foresight. Projections of an ultimate population size of 12 billion have been forgotten. In 2003, the United Nations offered a middle projection of 8.9 billion as the ultimate peak world population. A March 2004 report by the U.S. Census Bureau projected a most-likely scenario of 9.1 billion by 2050, with average fertility below replacement level and with hotspots of elevated mortality.

My own view is even more optimistic: world population is unlikely to rise above 8 billion (from approximately 6.4 billion today), and the fertility rate will fall from the Population Reference Bureau’s 2003 estimate of 2.8 children per woman to below replacement level within the next dozen years. With population size peaking at a level lower than either the Census Bureau or the United Nations project, much excess mortality may be avoided.

Fertility and Opportunity

Why do I believe this? Because my data show that people faced with real *or perceived* deprivation typically exercise reproductive caution. Whether in hunter-gath-

erer or agrarian societies, or developing or industrialized countries, intimations of scarcity (with respect to wants as well as needs) encourage restraint. And in the near term, expensive fossil fuels could trigger an acute sense of scarcity. Put another way, this *fertility opportunity hypothesis* proposes that people usually have as many children as they think they can afford, and that the motivation to have more or fewer arises from perception of economic prospects. Perceptions crystallize through comparisons to past experiences or a reference group.

Where straying above carrying capacity would terminally threaten life-support systems, *individual* evaluation of relative well-being often gives way to rigid, culturally embedded rules. The hierarchical social structure of indigenous peoples living in the Amazonian blackwater ecosystem is illustrative. With sparse game, few fish, and nutrient-poor soils, population size remains in balance with resources because only the few fortunate heirs to fishery and residential sites expect to marry and reproduce. Defined real estate rights are unusual in primitive societies but a less restrictive system might founder as population overshoot resources.

The fertility opportunity hypothesis suggests that rules atrophy, reproductive decisions become individualized, fertility rates rise, and populations explode when communities encounter new opportunities, such as those created by potato cultivation in Ireland around 1740, or by nitrogen fertilizer and foreign aid to underdeveloped countries during the twentieth century. Self-restraint is not rediscovered until economic prospects sour.

Anecdotal support for this idea is plentiful. For example, a Cairo slum dweller says, “We’re just surviving.... Certain days we don’t eat...I don’t understand how people with seven or eight children survive.” Pondering what she would do differently if she were rich, an Ethiopian mother of five says, “If I were wealthy, say if I had horses and a better house, I’d have more children.” A Russian mother of two who has relied on abortion to limit family size muses, “I would have had more children if life were better.” Near Mexico City, a Roman Catholic mother of two defends her use of contraception: “Things are difficult here....

Jobs are hard to come by.”

Stronger support can be found in a number of case histories, several of which I’ve summarized below:

- **Rwanda.** The Rwandan population quadrupled between 1950 and 1993. Although designed to help, moves to virgin land and the agricultural assistance given farmers were arguably not constructive in the long run because they promoted a frontier mentality, including idealization of large families. Observes demographer John May, “...the relative availability of land during the agricultural colonization and intensification processes might have been conducive to higher fertility levels.”

The fertility rate in 1987, a decade before Hutu massacred Tutsi, was 8.5 births per woman. By 1992, it was 6.2, a decline of more than two children per woman within five years. This ostensibly demonstrated the effectiveness of family planning programs launched some years earlier. As late as 1992, however, only 12.9 percent of married, reproductive-age women used modern contraceptive methods—hardly sufficient to account for the two-child decline in the total fertility rate. May suggests that the actual behavioral change that promoted lower fertility was delayed marriage.

Rwandans became infused with a new sense of caution when gains from intensifying agriculture and dispersing the population ran their course. Subdivision in each generation made family plots too small—by 1984, 57 percent of holdings were less than one hectare—for their many uses, including cultivation, pastureland, and fuelwood. Moreover, droughts increased and marginal land brought into cultivation 20 years earlier was losing productivity. A pervasive image of limits apparently made family formation less attractive, inspiring marital and reproductive self-restraint.

- **Brazil.** Referring to a poverty-stricken region of high effective population density, sociologist George Martine has written, “Brazil’s poorest socioeconomic region, the Northeast, has undergone the fastest fertility reduction over the last 20 years: there, the TFR [total fertility rate: roughly, the average number of live births per woman] has fallen from around 7 in 1970 to 3.7 in 1990.” Martine observes that the commonly men-

tioned “demographic transition variables,” including women’s education and participation in the labor force, did not cause the fertility decline. He suggests that the underlying mechanism was an unforeseen aspect of modernization: new expectations set up large sectors of the population for disappointment.

- **Egypt and Morocco.** Philippe Fargues and Youssef Courbage, studying Egypt and Morocco respectively, suggest that fluctuations in household economies affect fertility rates. In both countries, flows of widely distributed new wealth stimulated childbearing. The source



Paul Harrison/Still Pictures/Peter Arnold

Good times ahead? Perceptions of improving prospects may lead to larger families (Brazil).

(private income or government-subsidized housing, food, healthcare, and education) appeared not to matter. Fargue and Courbage concur that modernization—including reductions in infant mortality, better healthcare, education (especially for women), and rising standards of living—were *not* correlated with declining fertility rates and clearly *were not* causally related to them. In both countries, economic retrenchment with increasing disparity between aspirations and reality underlay the fertility decline. Sustained fertility reduction began when governments reduced subsidies, women entered the workforce to make ends meet, and the tax burden on families rose.

In Egypt (which has the longest history of concern over its expanding population of any Muslim country), Gamal Abdel Nasser encouraged family planning programs, and fertility declined during his tenure from 6.7 births per woman in 1960 to 5.0 births in 1970. Nevertheless, Fargue denies that programmatic family planning efforts caused the fertility decline. He cites, instead, new pressures coincident with the economic recession through which Egypt floundered until after Nasser's death. When Anwar El Sadat came to power in 1973, he encouraged domestic entrepreneurial activity, emigration, and foreign investment. He also signed a formal peace treaty with Israel (the Camp David accords) that still brings Egypt \$2.5 billion per year in aid from the United States. This aid, along with oil revenues and fees for foreign shipping through the Suez Canal, funded expansion of social programs. Remittances from expatriate Egyptians—which by the early 1980s amounted to US\$5 billion a year, the equivalent of 90 percent of Egypt's annual export revenues—augmented income in many families.

These dollar flows contributed, Fargue observes, to “a substantial increase in the standard of living” through el-Sadat's early years. “Now better off, families could more easily satisfy an unchanged desire to have numerous offspring.” The fertility rate did indeed spike, rising 30 percent from 1970 to 6.5 births per woman in the early 1980s.

President Hosni Mubarak, successor after El Sadat was assassinated in 1985, inherited a deteriorating economy and was soon forced to scale back social programs and subsidies. Awareness that the historically huge population was causing massive underemployment and shortages in arable land, food, and water became acute. The eroding standard of living apparently gave impetus to preferences for smaller family size. Between 1988 and 2003, the Egyptian TFR declined from 5.0 to 3.5 children per woman. The parallel, downward trends in socioeconomic indicators and fertility rates support Fargue's contention that, “Egypt's demographic transition has been driven not so much by economic development as by its hiccups.”

• **Asia.** The nine former “Asian tigers” (Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan, and Thailand) vary greatly but each is modern and vibrant in at least one primary sector. During late summer of 1997, the nine tigers temporarily reversed from economic growth to stagnation. The downward spiral began with a 40-percent currency devaluation in Thailand, and quickly spread.

In Japan, unemployment rates in 1998 and 1999 rose to their highest level since 1953. Personal bankruptcies in 1999 were 50 percent higher than in 1997 and, as a further sign of falling incomes, retail sales declined through 1999. In 1998, the Japanese suicide

rate was the highest recorded. Contemplating an uncertain future, a majority of university students expressed a preference for government as opposed to private-sector employment.

In print, I predicted that the economic collapse would cause fertility rates to decline at a faster rate during the 1997–1999 interval than during preceding two-year intervals. Fertility was trending downward to varying degree in each country, but I expected steeper declines. And in fact the percentage decline in the 1997–1999 interval proved more than six times as great as the average of declines in previous intervals, a statistically significant difference. In contrast, a comparison group of countries that experienced no particular economic shock showed random variation in fertility rates.

Nearing Limits?

Regarding the future, one searches for factors that could have a decisive effect on perception of economic opportunity and, therefore, fertility rates. My candidate is fossil fuels.

The availability of energy is one of the key influences on the evolution of human culture, and some scholars have even suggested a relationship between energy use per capita and population size. For 21st-century civilization, oil and gas are unparalleled sources of energy, and their penetration into the depths of the economy is profound. Not only is transportation radically dependent on oil; petroleum products are also the feedstock for myriad industrial and agricultural processes. As pesticides and fertilizers, petrochemicals are *irreplaceable* in high-yield modern agriculture. Physicist Albert Bartlett famously said that industrialized agriculture uses land to turn oil into food, and economist John Gever and his colleagues have suggested that by approximately 2020 agriculture will be recognized as the highest use of fossil fuels.

Colin Campbell, a retired oil industry geologist and editor of the newsletter for the Association for the Study of Peak Oil (ASPO), and electrical engineer Richard Duncan were among the first to write that energy price is a major causal factor in economic growth rates. Until relatively recently, however, most public discussions were dismissive. Through the decade of the dot-com bubble—which was favored by very cheap energy for much of its run—one heard instead of the de-coupling or de-linking of oil and economic growth.

Smarter business analysts began to reverse course in late 2002. Martin Wolf, writing in the *Financial Times*, said that “a rise in the price of oil reduces real income and real wealth, squeezes profits, and transfers incomes to oil-producing countries, all of which will be contractionary.... Changes in unemployment have consis-

tently followed changes in the real price of oil....” His article featured a chart showing higher unemployment rates in oil-importing countries lagging higher oil prices by two to three years during the period 1970–2002. Most U.S. recessions since World War II have followed a period of rising oil prices.

High-priced energy depresses business, prolonging recessions or stagflation. Farmers reduce fossil-fuel-based agricultural inputs, substituting organic and no-till methods. Although these methods are theoretically ideal from the perspective of sustainable agriculture, the human cost includes smaller crops and pricier food than with industrial agriculture.

Is such a future upon us? Numerous geologists, physicists, and engineers (including, but not limited to, Colin Campbell and his colleagues at ASPO) calculate that a plateau and then decline in petroleum, natural gas, and liquid natural gas (LNG) production will commence within five to ten years. In 2002, the executive vice-president of Exxon-Mobil publicly revealed that oil discovery (the rate of finding new reserves) peaked in the 1960s. In January 2004, Royal Dutch/Shell shocked markets by slashing its estimated oil and natural gas reserves by 20 percent, thereby reducing its reserve life by about one-quarter. Echoing these revelations, El Paso Gas announced in February 2004, a sharp reduction in its proven reserves of natural gas.

Depletion in some regions has not yet manifested itself in lower global production, primarily because swing producers in the Middle East, especially Saudi Arabia, Iran, and Qatar, have driven production higher than may be optimal in terms of maximizing total eventual recovery of oil in the ground. Consumers, too, prefer maximizing near-term production because it drives down price.

Political perturbations, rather than producer countries husbanding a resource that has scarcity value, are the major factors in current pricing. Nevertheless, depletion-driven, higher-priced energy may be in our future.

This brings us to the data supporting the connection between the availability of energy and population trends. The invention of multiple ways to harness the energy in

wood and coal launched the Industrial Revolution and rapid population growth. Fossil fuels accelerated these trends, with population expanding six-fold during the first half of the Oil Age (1859 to approximately 2000), according to Richard Heinberg. Energy economist Vaclav Smil observes that, “Population density increased substantially in countries with intensive agriculture only after the use of nitrogen fertilizer became common.” After inventions in 1909, synthetic ammonia—made mostly from natural gas—began replacing natural sources of nitrogen and now accounts for essentially all inorganic



Jorgen Schytte/Still Pictures/Peter Arnold

Cairo tenement dwellers air their laundry. Approximately a third of Cairo's 16 million inhabitants live in slums.

nitrogen inputs to agriculture.

More specifically, the decades between 1950 and 1970 saw a near doubling of the per-capita use of industrial energy worldwide, from 1.03 to 2.04 kilowatts (kW). The rate of increase slowed in the following two decades, 1970 to 1990, when per-capita energy use increased from 2.04 to only 2.19 kW. With respect to oil alone, production and use peaked in the early 1970s at approximately 2.3 liters per person per day. By 2000, per-capita oil consumption had declined to approximately 1.7 liters per day.

Trends in world population growth roughly track the fluctuations in per-capita energy use. Population plotted on a semi-logarithmic scale yields a curve that



Haruyoshi Yamaguchi/REUTERS © 2002

A homeless man harvests aluminum cans for 78 U.S. cents per kilo (Osaka, Japan).

bends steeply upward, away from a straight line, from at least the beginning of the twentieth century until nearly 1970. That is, population size grew at *an accelerating rate so long as petroleum consumption per capita was also rising rapidly*. Between 1965 and 1970, world population growth slowed from its trajectory of 1.9 percent annually to the lower rate of 1.7 percent. By 2000, it had slowed to 1.4 percent annually. “Population momentum,” the phenomenon that successively larger generations drives birth rates higher even when individual fertility is low, accounts for a lag between declining per-capita energy use and decline in the population growth rate.

Coal, nuclear, and renewable energy sources, combined with increasing efficiencies, may mitigate the effect of a plateau in oil and gas production. If not, the demographic effects of a no-growth or declining economy may be profound. Assuming some lag time, which could be relatively short, Colin Campbell comments that, “...the consequence of peak oil may be peak people.”

Caution: Children

Children are very costly in energetic terms, so it is to be expected that humans have evolved to avoid or undo reproductive mistakes. Cautious approaches to childbearing allow hoarding of resources for the most propitious opportunities, theoretically maximizing total reproductive success and giving the next generation a competitive edge.

My data suggest that persons who perceive improving conditions make expansive reproductive choices, relaxing prudential behavior and pleausurably anticipating large families. Today’s young, however, largely expect narrowing opportunities. Anticipating difficulty in providing for children at a personally acceptable standard, they tend to be cautious about incurring family responsibilities. They avoid childbearing while single, delay marriage, and space children within marriage.

Choices may narrow rapidly if certain energy futures materialize. Rising energy prices may cause retrenchment in living standards. Food surpluses will disappear if growing national populations raise domestic demand, and price-induced reduction of petrochemical-based fertilizer and pesticides cut yields. Domestic demand will usually be satisfied before food is exported unless a severely

indebted nation must sell to survive; export of food needed at home is a recipe for social unrest. But it is likely that, before these scenarios emerged, the native-born population and established residents would respond with marked reductions in their fertility rates. Barring mass immigration, population would begin to stabilize.

A public that opposes immigration and practices reproductive self-restraint has embarked already on a promising adaptation to petroleum depletion. Governments should support—rather than oppose, as they often do—both aspects of this adaptation. All else equal, a country with a stable or shrinking population is better positioned to cope with increasingly expensive energy. Worldwide, a future marked by declining energy use per capita may be the ultimate driver of population stabilization.

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References and readings for each article are available at www.worldwatch.org/pubs/mag/.