Population and the Environment:

Too Many People and/or Poor Management of Resources?

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"I would like you to carry away all four words: population, environment, economics, and culture. When people try to sell you a short list with only population on it, don't buy it."

The nominal subject of today's symposium is to discuss interactions between population and the environment. The title contains a hint that there is more to this conference than simply the population and the environment because it says, "What about management?" This phrase suggests that population and the environment are affected by their interaction with the economy. The economy, in turn, influences the management of the environment. The title of the symposium also includes the words, "poor management." "Poor" is not a scientific word. It is a value-laden word. It has to do with culture and with what we want from life. Poor for whom, under what circumstances, and with respect to what standards of desire? Thus, embedded in the title of this symposium is also this theme, albeit a little hidden. I would like you to carry away all four words: population, environment, economics, and culture. When people try to sell you a short list with only population on it, don't buy it. Or if people try to sell you a short list with only population and environment on it, don't buy it. Or even if the list has population, development, and the environment, don't buy it. What people want from life and what they value is a part of understanding the dynamics of the whole system – including population, economics, environment and culture.

Where do we stand today with regard to the global population? At present, the population of the world is at six billion people. The global population has increased by more than the population of the United States in the last four years. Several years ago, the annual incremental increase was 90 million. Now it is 80 million (78 million by the United Nations estimate). The annual incremental increase has dropped to about 1.3 percent per year. The population is getting big very quickly, while the growth rate is declining rapidly. Our doubling time at the

current growth rate is over fifty years. Hence, even at the new, lower growth rate we would still double in fifty years.

How did we get to this state of affairs? Well, about two thousand years ago there were approximately a quarter of a billion people in the world, which is the population of the United States today. We had a quarter of a billion people, and it took approximately 1650 years for the population to double to a half billion people. Since the last ice age, which occurred about 12,000 years ago, the average population doubling time was approximately 1650 years. That is, every 16, 17, or 18 centuries the population doubled. Around 1650, the Old World and the New World began to exchange people and resources, and the growth rate of the population picked up because the death rate dropped. Although there were massive deaths in the New World due to infectious disease, an improvement in nutrition in the Old World meant that death rates dropped and population growth picked up. The combination led to the population doubling in less than two centuries, as opposed to 16.5 centuries! The world population reached one billion around the year 1827.

Then the Industrial Revolution began, and the wealth of the people increased again. Their health improved. The next doubling, from one billion to two billion, took only one century, instead of taking two. We passed two billion around 1930. If a population is growing exponentially, the doubling time is constant. Thus, if we had exponential growth, it would have taken 16.5 centuries to go from a quarter to one-half billion. Then it would take another 16.5 centuries to go from one-half to one billion, but it only took two centuries. If it were exponential growth, it would take another two centuries to go from one to two, but it only took one century. In the 1930s, antibiotics and sulfa drugs were discovered, and the next doubling (from two to four billion) took only forty-four years, instead of taking another century. We went to four billion by 1974. Now in 1999, there are six billion people on the planet. We passed three billion people in 1960, which means the last doubling took less than forty years.

The growth rate accelerated by a factor of forty in the last 350 years. We went from doubling in 16.5 centuries to doubling in thirty-nine years. This is analogous to a savings account in which the interest rate keeps going up with the account balance. If you can find such an account, I would like to invest!

The net result is that the second half of the 20th century is the first period in the entire history of the human species in which the Earth's global population doubled within the span of a single human lifetime. The population has tripled

since 1930. If there is anybody in the room born before 1930 you have seen the population triple in your lifetime. This has never happened to anybody before. In absolute terms it took from the beginning of time until 1830 to put the first billion people on the planet. We have added the most recent billion people in just 12 years, so this is a new ball game demographically.

I am going to focus on the last fifty years, and more specifically, on two important facts. One is what I consider to be the most important demographic event in the history of the human species. The growth rate of the world reached its all time peak of about 2.1 percent around 1965-70 and then gradually began to decline. In the 14th century, the growth rate of the population dropped when the Black Death killed one-third of the population of the world between India and Iceland. The difference between then and now is that death rates in the 20th century continued to go down while fertility, largely under voluntary control, began to drop. (The turnaround occurred before China's one-child policy began.) To conclude, the most important demographic event was that the human species got its fertility under control and began to reduce it.

The second point requires that I tell you a little story about an ecologist, an economist, and a statistician, who went on a deer hunt with bow and arrow. They were stalking through the forest and suddenly spotted a deer. The economist took careful aim, fired, and as we would expect, the arrow landed five meters to the right of the deer. The ecologist took careful aim and fired, and as you would expect, the arrow landed five meters to the left of the deer. Then the statistician looked at the two arrows and looked at the deer and jumped up and down and shouted, "We got it! We got it!"

The point of this story is that hunting the deer with the average arrow is no more useful than understanding the world situation with globally average statistics. With respect to the world's population there are, in fact, two distinct worlds. (There are many more, but for our purposes there are at least two distinct worlds on this planet.) One world is the poor world, and the other is the rich world. I want to tell you their separate stories.

In the rich countries, the population growth rate had begun declining more than a century ago. It continued to decline, and it is still declining. The poor countries had a much lower rate of growth than the rich countries for much of the 20th century. But after World War II, the rich countries learned how to export health without exporting wealth. They exported cheap public health measures,

which dramatically lowered infant mortality in poor countries. As a result the population growth rates of those countries shot up at an unprecedented and unpredicted rate. It took from the end of World War II until 1965 for the poor to bring their fertility down. Then the world as a whole turned the corner.

Here is a photo of the poor world and the rich world living side by side in Dacca. It is not just numbers of people, but it is the quality of life that is our concern.

Let me tell you a little about the poor world and the rich world. First, about eighty percent of the global population lives in the poor world, and twenty percent (1.2 billion) lives in the rich world. The rich world consists of North America, Europe, Australia, Japan, and New Zealand. Some people would include the small countries of Asia that have had very rapid progress, but they are in the middle. The doubling time of the rich countries is about five and one-half centuries. That is, if their present growth rate were to continue (which it will not), their population would double in five and one-half centuries. If the present growth rate of the poor countries were to continue, their population would double in thirty-eight years. What that means is that in one lifetime, at these growth rates, the poor countries would double once then double again; that is a four hundred percent increase. At these growth rates the rich countries would grow by about eight percent. Therefore, there is a massive shift in the relative sizes of the poor and rich sectors of the world. The only way out of this situation is for the poor countries either to lower their growth rates demographically, or for the rich countries and the poor countries to work together to move the poor countries into the category of rich countries.

Population density of the poor countries – twenty-two people per square mile – is more than twice that of the rich countries. An infant born in the poor countries has a seven times larger chance of dying before the age of one as does an infant born in the rich countries. The average woman in the poor countries has about twice as many children in her lifetime, at present rates, as the average woman in the rich countries. There are more children in the poor countries and one out of three people is under the age of fifteen. In the rich countries, one out of five people is under the age of fifteen. There are more elderly over sixty-five in the rich countries than in the poor countries. In the rich countries, one out of every seven people is above the age of sixty-five.

A very important difference between the rich and the poor countries is that three out of four people in the rich countries live in cities, whereas about one out of

three people in poor countries live in cities. This means that two-thirds of the people in the poor countries are living in the countryside, and are therefore in direct contact with their rural environment.

Why am I calling these "rich" and "poor" countries? Because the average income per person in rich countries is about $19,000, and the average income per person in the poor countries is about $1,100.

There are many problems that are associated with being poor and numerous. One problem is that about one out of three people on the planet is infected with a bacillus of tuberculosis. In Africa roughly every other person is infected with a bacillus of tuberculosis. About one-half of the people in the world have no place to go to the toilet, with attendant health consequences. There are about a billion illiterate adults of whom about two-thirds are women.

With people, come domestic animals and plants. In fact, that is why the College of Natural Resources was founded as the College of Agriculture. Large domestic animals – cattle, sheep, goats, pigs, buffalo and camels – together number about 4.3 billion. They outweigh the human species, and their numbers are increasing more rapidly than the human species. In addition there are about 17 billion chickens on the planet, and their numbers are increasing even more rapidly. Together these domestic animals, over the last twenty years, have consumed forty percent of all the grains consumed. What that means is that, on average, over the last twenty years, for every three kilograms of grain that go into a human mouth another two kilograms of grain go into the mouths of domestic animals. If we are feeding 6 billion people with our grain, we are feeding the animal equivalent of another 4 billion people with our grain in the form of animals.

Here is a slide of goats actually climbing tress in Morocco in order to reach branches that still have leaves. The photo illustrates that there is an environmental impact of domestic animals in Morocco, and that the chance of regeneration of its forest is rather slim.

Let me turn briefly to the economy. One index of economic activity is the use of energy. In 1860, the average inanimate energy use per person was approximately one megawatt-hour, per year. Now what is a megawatt hour per year? It is just enough energy to fuel me. Roughly speaking, you can think of a human being as a one-hundred-watt light bulb. If you multiply that by the number of hours in the year you get one megawatt-hour per year. Thus, each person in the world had roughly the energy equivalent of one human being as a slave, for whatever purposes

the energy was used. By the year 1990, the average person of the world had nineteen megawatt-hours per year. This is the equivalent to every person on Earth being followed around by nineteen energetic slaves operating the lights, the jet that brought me here, the projector, our cars, and all of the things that we do with energy.

At the same time, the population went from a little more than one billion to a little more than five billion. We had a fivefold increase in the number of people and a nineteen-fold increase in energy per person. This means we had a ninety-five-fold increase in the inanimate energy production for human use over 130 years. For comparison, around 1950 our inanimate energy production exceeded the amount of energy that the sun delivers to the earth, in the part of the spectrum that can be used for food production over the continents (not the oceans). We are now at four times that level. Our energy production places us among the geological forces that we face on the earth. The vast bulk of the energy production was by the consumption or combustion of fossil fuels.

It is not only energy that drives an economy but people too. The majority of the world's farmers are women. Women's role in the economy has changed very radically in the last generation. In 1970, for every 100 men who were economically active (meaning working for pay or looking for pay), there were 37 women. This ratio varied widely from a high proportion of female workers in Eastern Europe to a low proportion in Asia and the Pacific. Only 20 years later, for every 100 men in the labor force there were 62 women – practically a doubling. This indicates, by the way, how culture interacts with economy and demography. The labor force increased much more rapidly than the population because women moved into economically paid jobs. This means the labor force is not dependent solely on population growth, but also on what is a culturally acceptable and economically acceptable activity for women. That raises all kinds of questions about who is taking care of the children and the old people in the economies that have experienced dramatic changes in female labor participation.

Here is a slide of three teenage Bangladeshi women, gravel makers. They have the unenviable job of taking large rocks and crushing them by hand to make small rocks. This slide illustrates that this transition raises an unresolved task of balancing the jobs of production and reproduction.

During this period, the balance of agriculture had shifted in favor of the rich countries. In the 1930s, the developed countries like the United States were

importing food from the developing countries. Now the developing countries are importing massive amounts of food from the developed countries. Wheat cereal yields have continued to rise steadily, and the prices of major cereals have dropped dramatically. There was a spike in 1973 during the oil crisis, but in general, in world commodity markets, the price of basic cereal grains is cheaper than it has ever been.

A very good consequence of the decrease in wheat prices is that the number and fraction of people in the world who are chronically hungry (that means waking up hungry and being hungry all day and going to sleep hungry, and then hungry the next day) has dropped quite dramatically. In 1970, nearly a billion people were estimated by the FAO to be chronically hungry – more than a third of all people in the developing regions. By 1990, that statistic dropped to three-quarters of a billion people, and to twenty percent in the developing regions. That is the good news. The bad news is that in Africa, the number of chronically hungry people has grown by two-thirds – from 100 million to 168 million. That number has remained constant at about one in three people in Africa. Every third person from Africa does not have enough food to grow normally and to walk around. That is the region that experienced the most rapid population growth. In fact, during this period the population grew by about two-thirds – just like the number of people chronically hungry.

Therefore, people who say that population growth is limited by food production are not facing the fact that Africa is the hungriest region in the world and has the most rapid population growth while America and Europe have an abundance of food and have a much slower population growth. By doing a cross-nation comparison, it is clear that food production is not a limit on population growth.

Economists call the period since World War II the Golden Age of the World Economy. If you index the prices in 1990 at 100, the price of petroleum dropped from 113 to 76, between 1975 and 1992. The price of gasoline at the pump (until the last few weeks) was cheaper than it had ever been in the last half century. Non-fuel commodity prices dropped from 159 to 86. All food commodities dropped from 196 to 85. Over this period, metals and minerals dropped from 135 to 83. This was the Paul Ehrlich and Simon bet which Julian Simon won. The only thing that got more expensive is timber because we do not know how to make trees grow big and old faster. So the price of timber on the stock rose from 62 to 112. That

was the good news – that prices have been dropping.

Here is the bad news: economic inequality has increased dramatically over the last century. Consider a distribution of the world's population by income per person. In 1960 one-fifth of the people at the top of the income distribution got 70.2 percent of the entire world's income while the bottom fifth got 2.3 percent. This is about a thirty to one ratio. The average person at the top of the heap got thirty times the income of the average person at the bottom of the heap. In 1970 the ratio went from thirty to one, to thirty-two to one; in 1980, forty-five to one; in 1991, sixty to one. Inequality is growing. Within the United States economic inequality has also been growing dramatically over the last forty years. If you analyze income distributions within countries you get a similar result. There is much more uncertainty about this because a lot of countries do not want to publish their income distributions because it is politically embarrassing.

How is it possible, if the price of food dropped by more than half, that there can still be more than three-quarters of a billion chronically hungry people in the world? The answer is that the very poor are economically invisible because they have no cash to play in world commodity markets. If you do not have any cash you cannot exert what economists call "effective demand." Your hunger is not sensed by world commodity markets because you do not have any cash to make a bid in the market. So the use of prices as an indicator of scarcity is not a reliable indicator of human well being when there is a very inequitable distribution of income. This point leads us to question the use of economic indicators as measures of human well-being.

Let us turn from population and the economy to the environment. Although fossil fuels are the major source of energy, hydroelectric dams are also important. The volume of water in all of the dams on the earth is somewhere in excess of 10,000 cubic kilometers. Ten-thousand cubic kilometers is about five times the volume of water in all of the world's streams and rivers, and is enough to affect the rate of rotation of the Earth; the water has been moved from the tropic oceans to the land masses of the Northern Hemisphere. A few people have actually estimated how much this change affects the rate of slowing of the Earth's rotation. Once again, humans have become a geological force on the planet.

Here is a slide of a garbage dump in Warrington, Great Britain. What these and other dumps have taught us is that there is no longer any "away" to throw things away to. We simply move waste from one place to another. The largest

human made structure ever is the Fresh Kills Landfill on Staten Island, in New York City. It is about one hundred meters high and is nine square kilometers (three kilometers by three kilometers). Its volume is bigger than the volume of the Great Wall of China. And the Fresh Kills landfill can be seen from the moon.

Here is a slide of Love Canal, another scene in New York – proof that people make plutonium and toxic chemicals as well as Green Revolutions. This is a slide of Western Vancouver Island. Once eroded, the soil on these slopes will not regenerate for a very long time.

Here is a slide that shows population density and the fraction of land still covered by forest in sixty tropical countries in 1980. The main message from this slide is: As population density goes up, the fraction of land covered by forest goes down. Not surprisingly, most forestland that gets cleared is converted to agricultural use.

Let us consider another example. The typical population density for the United States is around thirty people per square kilometer. Population density ranges from twenty-five to eighty percent on forestland. Population density does not uniquely determine the rate of deforestation. Deforestation also depends on economic factors like the interest rate. For example, in Brazil when the interest rate is low, capital is cheap and roads are built into tracts of virgin forest. These roads make it easier for peasants to settle the inner-forest, and to deforest large areas of land. When the interest rate is high, roads cannot be built easily, and the large blocks of land are only nibbled at from the edges. Government regulations, about who owns these large tracks of forest and what their obligations are, can further effect deforestation. To conclude, it is not only population versus the environment, but rather their interaction with culture, government, and the economy.

Another example of the interaction between the economy and the environment is that ninety-eight percent of all the animal extinctions since 1600 are a result of human economic activities. Thirty-six percent are the result of habitat conversions. Twenty-three percent are a result of hunting for food and for sale, and about thirty-nine percent are a result of introducing other species for human purposes.

Here is a slide that shows how simple extrapolations of the future would not have worked in the past, and there is not much reason to expect them to work in the future. Up to 1960, when the Earth's population was 3 billion, the area under cultivation increased linearly. Since 1960, the area under cultivation has been

almost flat. Haber invented the ammonia nitrogen fixation process around World War I, and around 1968 the first Green Revolution varieties of rice were introduced. The wheat varieties were deployed, and the yields took off in the 1960s, whereas the land area devoted to agricultural use leveled out. A straight-line extrapolation of any one of these factors would have been completely wrong. The Green Revolution has brought a few environmental problems, which if you ever read a newspaper in the last 20 years, you are quite familiar with.

I have spoken about population, economy, and environment. I want to close by emphasizing that those three factors are not sufficient: We also have to talk about culture. This is a photograph that was published in the New York Times, March 26th, 1993. The caption says, "In a move meant to placate the west, the Sudan east government is opening parts of the country's famine stricken south to relief operations, but for some it could be too late." This is a little girl, and this is a large vulture. Now for some people this picture shows that Africa has reached or exceeded its human carrying capacity. There are just too many people there. I would like to discuss this picture with you in some detail.

First, there was an environmental problem. The rains did not come in the Southern Sudan largely as a result of a natural event. Secondly, there was a crop failure, and that is partly a consequence of the absence of rains and partly an economic event. No one invested in dams and irrigation to assure a water supply in the event of a drought. Third, there was another economic failure: There was no market to meet the demand for food, and there was no cash in the hands of poor people to buy food. Fourth, there was a political and cultural catastrophe. The people in the south rebelled against the central government, and the government of the north decided that it was less expensive to starve people than to shoot them. This girl's starvation is a direct result. Attributing this catastrophe to overpopulation is a simplification that misses several key factors that contributed to the famine.

In the last few years, I have realized some additional things about the Sudan situation, with respect to historical and personal responsibility. Why was there a civil war between the people of the south and the people of the north? The area of Sudan was defined by the departing colonial powers. The boundaries are straight lines that were drawn on a map. The colonial powers arranged the boundaries of the country to reward the cultural groups in the north that had sided with them in suppressing the groups in the south, who had been militarily disorderly. By defining the perimeters of the country in this way, they set up a continuing internal conflict,

which has killed about 1.5 million people since 1981. We do not hear much about the Sudan. The fact is that there has been a tremendous continuing ethnic conflict, on par with the conflicts in Kosovo and Rwanda, going on in the Sudan for years.

The next dimension is the personal. What were the parents of that girl thinking? Or were they thinking? What access to health care and to contraception did they have? How aware were they of their situation? What was the responsibility of the parents? Finally, what is my individual responsibility, being aware of this situation, as I have been for some years, in trying to prevent this situation from continuing or in rectifying it? I believe that at least I have a responsibility to increase awareness of this situation, and maybe collectively we can find ways of addressing it. My concluding point is that this girl starved, not just because the population exceeded the local carrying capacity, but as a result of a complex chain of causes, including many human choices.

Question and Answer

Q: Would you comment on Russia as an example of how these factors interact in the former Soviet Union, which we used to consider a developed country. Now it has many characteristics of an underdeveloped country, environmental disasters, and so on.

A: The question was: Would I please comment on Russia and the former Soviet Union which used to be considered a developed country and, in many respects, has lost that status because of its environmental and other problems. I am not an expert on Russia. I can tell you that demographically the life expectancy of men in the former Soviet Union has dropped by ten years in the last decade. It is now around fifty-seven, which is a setback on the same order of magnitude as that in central Africa, in the AIDS belt. The cultural system of central planning there, and the economic accounting system, which took no account of environmental impacts and ignored the effects on the health of many citizens, led to extraordinary environmental damages, which we are now only finding out about. The disposal of nuclear submarines, by simply pulling them off the slope of the continent on the north and sinking with their nuclear power plants intact just on the continental shelf, may have been a move for which we will all pay in the not very distant future. So it is a good example, but I am not prepared to give you a little dissertation on what happened there. Clearly population, environment, economy and culture are interactive in this complex. If you happened to bring a book on this, I would buy a

copy.

Speaking of that, if you want background on what I have been talking about I have a book called, *How Many People Can The Earth?* which is a paperback, available for $15 or $16. With a twenty percent discount you can get it down to $12 or $13 at Barnes and Noble.

Q: Thank you for a riveting presentation, causing a lot of us to think very deeply about assumptions and presumptions. I have one question. You implied that whenever the population has gotten to the 3 billion mark, technology has come to the rescue. We also know that certain technologies have some pretty drastic environmental impacts. What kinds of technologies do you see as offering promise, and which ones also are potentially quite hazardous?

A: I think every technology has potential dangers. I think every technology that gives people power gives them the power to use it for good and for ill. Often the ill that follows from technologies is ill that we are not smart enough to have foreseen, in addition to whatever ill comes by sheer malevolence or misuse. So my view of the interaction of humans with technology is that it is like walking or running. We are not in stable equilibrium where we can just lie down and be at ease. If you ever watch a child learn to walk, walking consists of falling forward and putting your foot in just the right place at the right time. Then you fall forward again, and you put your foot there just in time to catch yourself. That is what technological progress is also, we swing ourselves forward and we try to catch ourselves so we do not fall over on the next step. So the high intensity agriculture that we cultivated in the 60s, during the Green Revolution, led to contamination because we did not manage the nitrogen fertilizers wisely, and they ran into the ground water and eutrophicated fresh water supplies. I see information technology and biotechnology as the promising technologies for the next century. I think the promise of these technologies is extraordinary. If we could monitor each square meter of a farmer's field and know which square meter needs fertilizer and which square meter needs water at all times during the growing season, we could dramatically reduce the amount of material that we have to apply to a farmer's field. We could use that information to control the amount of fertilizer, quantity of seed, and the type of seed, so that they correspond with the particular characteristics of that square meter of soil. We could trade materials for information, and we would have much more productive agriculture.

The other side of that would be biotechnology. At the beginning of the century, we did not know what a gene was. In 1903, we found out that they were located on chromosomes. In 1944, we found out that they are made of DNA. In 1953, we found out what DNA is made of. In 1995, we sequenced, for the first time, the complete genome of one non-viral organism, *hermophilus influenza*. Now we have 20 to 30 genomes. We still do not know the genome of a single plant, and yet we live on plants. In the next ten or twenty years, we are going to know lots of plants. There are people who have set out to sequence the genomes of thousands of species in the next quarter century. The book of life is going to lie open before us, and it is up to us whether we use that for food production or biological warfare. There is no technology that is intrinsically good or evil – it depends on how we use it.

Q: On one of your charts you have shown that the global population curve actually comes down, but as you may know, that is not true at all in the United States. In 1900, the United States had 70 million people. Today we have approximately 270 million, and projections indicate that by the year 2050, we could reach 590 million people. I wonder if you agree with Professor Ehrlich who says, "Impact on environment equals population multiplied by affluence multiplied by technology." In other words with 273 million, the United States does more damage to the world environment than do China's 1.25 billion people. I am hoping that environmentalists in this country also start focusing on US population stabilization. Of course we have to do whatever we can to help the worldwide population slow or come down.

A: There were a number of different issues raised there, and not one of them is simple. I am not going to try to pretend that they are simple. The curve that I showed that went down was the population growth rate, not the number of people. And the population growth rate is like the interest rate; it is not the balance in the account. It is true that the population of the United States has been increasing by about three million people a year in recent years and continues to increase at that rate. I am extremely skeptical about projections of the future of the United States population because they have so frequently proved to be wrong in the past. Where the United States population will be in half a century is a matter of choices to be made by you and me and our children and their children and the possibilities are extremely wide. So I am not going to raise alarm about the future when I think the

present is already sufficiently alarming.

Q: In the beginning of my graduate career, I was in city planning with Kingsley Davis. When we were calculating the figures, I was aghast at how lousy the United Nations demographic estimates were on all the countries where there were no censuses. We went through gyrations with Kingsley Davis to fix up the estimates. For the year 1970, we estimated 3.605 billion. My question is how confident are you in the estimates of population? I am suggesting that perhaps the initial premise of numbers is far less than maybe the fact.

A: The question was how reliable are our demographic statistics, and I think it is an extremely good question. My guess is that we do not know the population of the world to the nearest quarter billion. It could be a quarter billion less. It could be a quarter billion more. So the United Nations has announced that the world is going to pass a population of 6 billion on October 12th at 2pm, but they have not told us which time zone yet. That is a political activity intended to dramatize rapid population growth. We do not really know whether it is five and three-quarters or six and one-quarter. It could be even more uncertain than that. Remember, the United States, which spends more money on its censuses than any other country in the world, cannot get it right to better than two percent. So now if you take two percent of 6 billion, that is 120 million. So really there are countries in the world that have never had a census, and the United Nations must rely on the official numbers furnished to it by those countries. It cannot do anything else because it is a creature of those countries. It makes estimates and adjustments, but there is tremendous uncertainty. So I completely accept your reluctance about the underlying figures.

Nevertheless, if somebody tells me that the world population has not been going up for the last quarter century, I am extremely dubious about that. I think the world population has been growing very rapidly.

Q: You made some very useful comparisons between the wealthiest twenty percent and the poorest twenty percent. I wonder whether you have ever made any such comparisons between much smaller fractions at the top versus maybe even a larger fraction at the bottom. The reason that I ask that is, at least in the United States, and I think across the world, the very, very small percentages at the top have enormous difference with very large fractions below.

A: Why do I not look at the tiny bit at the top? It is true that people at the top are fabulously wealthy. Actually, it does not bother me so much as the extensive poverty of the two to three billion people at the bottom. Just remember that there are 2 billion people living on the planet whose average incomes are about $400 a year. That is a dollar a day. In my values that is a moral disgrace. Certainly, for the health and well being of my children, it is a threat because they cannot protect themselves against infectious diseases, and infectious diseases do not carry passports. If I want my children and grandchildren to be healthy, I want poor people in other parts of the world to be healthy so that my grandchildren will not get infectious diseases from them. Therefore, I think that we have a self-interest in the well being of the bottom several billion no matter how much Bill Gates makes. I do not really care how much he makes, but I do care about the poverty at the bottom end.

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