

**BioEcon Conference 2016: King's College, Cambridge**

Keynote Lecture

**Human Population and Earth's Carrying Capacity**

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## Background Reading

Dasgupta, P. (2000), "Reproductive Externalities and Fertility Behaviour," *European Economic Review*, 44(2000), 619-644. (Presidential Address to the European Economic Association Annual Conference 1999)

Dasgupta, P. and P. Ehrlich (2013), "Pervasive Externalities at the Population, Consumption, and Environment Nexus," *Science*, 19 April, Vol. 340, 324-328.

Dasgupta, A. and P. Dasgupta (2016), "Socially Embedded Preferences, Environmental Externalities, and Reproductive Rights," Discussion Paper, circulated at the conference.

Nature responds to the demands we make of it, not to rates of changes in those demands, let alone to rates of changes in the rates of changes in those demands. This simple insight (made explicitly by Paul Ehrlich and John Holdren in a 1971 paper) has had little influence on either economics or demography. We heave a sigh of relief when told that the rate of global population growth is declining, but that is far from being told that we are heading toward a sustainable use of the biosphere. A long run population of 10-11 billion can be expected to make a far greater demand on the Earth system than one of 3 billion.

It pays to decompose the aggregate demand for ecological services that humanity makes on the biosphere into human numbers and per capita demand. As a reasonable approximation we take the latter to be an increasing function of per capita income (or consumption). Current global population size is 7.3 billion, enjoying a per capita income of 15,000 dollars (PPP).

The Millennium Ecosystem Assessment 2005 reported that 15 of the 24 major ecosystems that the authors had reviewed had either deteriorated or were currently being used at unsustainable rates. And there are hundreds of studies identifying local ecosystems that have deteriorated or been destroyed through excessive use or habitat destruction. As social scientists we are then obliged to ask why reasoned decisions at the individual level can nevertheless yield collectively unsatisfactory (even disastrous) outcomes. The collapse of past societies, a major field of historical study today, points to root causes. And they have much to do with "externalities".

## **Externalities**

Externalities are the unaccounted for consequences for others of actions taken by one or more persons. They are symptoms of institutional failure, which is why they cannot be eliminated without collective action. The institutional failures that underlie externalities are symptoms of the absence of appropriate property rights to goods and services (private, communitarian, or public). When externalities are adverse, the moral directives flowing from them can clash with the exercise of personal rights. (Examples: compulsory vaccination against infectious diseases, ban on smoking in public places, prohibition of discharge of poisonous chemicals)

Here I pay attention to population, most especially in sub-Saharan Africa, where the total fertility rate is still over 5, in contrast to the world average, which is 2.5 (in Europe it is less than 2). The classification of reproductive externalities that I offer here is prompted by the African experience. We could conduct a parallel study on the demand rich people make on the biosphere by their high consumption levels.

## **Classification**

**1 Environmental externalities.** These are standard to those attending BioEcon conferences. Nature is always on the move. Property rights to the natural environment are difficult to define and enforce. One reason is that Nature is constantly on the move. The wind blows, particulates diffuse, rivers flow, fish swim, birds and insects fly, and even earthworms are known to travel undetected. You cannot contain the atmosphere you befoul. That means you pass on some of the damage caused by a deteriorating environment to others without their consent.



## **2 Reproductive Externalities.**

2a. Cost sharing among kinship. Fosterage in sub-Saharan Africa.

2b. Children as substitutes for other capital assets. Lack of insurance markets and markets for producer goods (electricity, tap water).

2c. Socially embedded preferences.

These externalities can reinforce one another, leading to heightened demand for children and a greater demand for ecological services. Crude but suggestive estimates of the demand humanity currently makes on the biosphere suggest that adverse environmental externalities accompanying new births are significant. That leads me to search for estimates of the size of the global population that the Earth system can support at a decent standard of living.

UNFPA (1995) took it that family planning and reproductive health policies should address "unmet need", meaning that they should be made to serve women aged 15-49 who are seeking to stop or delay child-bearing but are not using modern contraception. "Total demand" for family planning is taken to be the number of women who want to delay or limit child-bearing (i.e. the sum of contraceptive users and women with unmet need). The role of family planning, the authors argued, is to supply that demand. The success of family planning can then be measured by the ratio of family planning users to the total demand. The United Nations have adopted this measure in their Sustainable Development Goals. Reproductive rights serve as the basis of their recommendation in each of the publications.

But there is a problem: Reproductive rights, when used to delineate the boundaries of family planning and reproductive health services, is at odds with the rights of future people to inherit a reasonably productive biosphere. So the UN stance undervalues family planning.

## **How Many People Can the Biosphere Support?**

It proves useful to regard the biosphere as a gigantic renewable natural resource, offering ecosystem services in units of biomass. If it helps, you could think of the biosphere as the familiar "r-K system". The stance involves a heroic aggregation exercise, in which billions of assets are aggregated into a single measure, but recall that global fisheries and forest biomes are routinely measured in units of biomass, which also involves giant aggregation exercises.

This approach has been almost entirely neglected. In what follows I make use of some very crude estimates of the Global Footprint Network's work on the demand humanity is making on the biosphere.

Students of bio-geo-chemical signatures of the past 11,000 years have provided a revealing sketch of the Anthropocene. They have noted that a sharp increase took place in the middle of the 20th century in the rate of deterioration in the workings of Earth's life support system. They proposed that mid-20th Century should be regarded as the time we entered the Anthropocene.

Their reading is consistent with macroeconomic statistics. World population in 1950 was 2.5 billion. Global GDP was a bit over 5 trillion dollars (PPP). The average person in the world was poor, with an annual income of a bit over 2,000 dollars (PPP). Since then the world has prospered materially beyond recognition. World income per capita today in rounded figures is about 15,000 dollars (PPP) and population has increased to 7.3 billion. World output of final goods and services is about 110 trillion dollars (PPP).

The Global Footprint Network have reported that in the early years of this century humanity's demand for ecological services exceeded by 50 per cent the rate at which the biosphere is able to supply those services to us. The figure is based on the idea of "global ecological footprint", which is the surface area of biologically productive land and sea needed to supply the resources a human population consumes (food, fibres, wood, water) and to assimilate the waste it produces (materials, gases). A footprint in excess of 1 means demand for ecological services exceeds their supply. If we take the current footprint to be 1.5, it means we need 1.5 Earths to satisfy our current demand sustainably.



An analysis of one set of global surveys on happiness and their relationship with household incomes has revealed that in countries where per capita income is in excess of 20,000 dollars (PPP), additional income is not statistically related to greater reported happiness. We work with that figure, even though we are not at all sanguine we understand the finding. 20,000 dollars is the per capita income in Panama, Cuba, and Uruguay today, and it is hard to imagine that happiness hits a roadblock at 20,000 dollars. Nevertheless, for want of price estimates of natural capital, I follow the lead of studies on reported happiness.

World income (or global GDP) today is about 110 trillion dollars (PPP). Using 1.5 as the figure for the global ecological footprint today and assuming that the demand on ecological products and services is proportional to GDP, we can conclude that sustainable world GDP is an annual 110 trillion/1.5 (i.e. 74 trillion), dollars (PPP). If we now regard 20,000 dollars (PPP) as the desired standard of living for the average person, maximum sustainable population comes to 3.7 billion. That was global population in the 1970s. So we are not talking of unfamiliar times.

How does the balance of rights change when we cease talking exclusively in terms of global averages? What if absolute poverty was to be eliminated by a redistribution of incomes toward greater equality? Such a policy has a strong appeal to egalitarian convictions. But policy makers would be faced with a cruel dilemma:

Suppose the demand for ecological services increases less than proportionately than income. Then an  $X$  per cent growth in mean income (leaving distribution unchanged) would be accompanied by a less than  $X$  per cent growth in the demand for ecological services. That's the good news. But there is a bad news: If and incomes were made equal leaving aggregate income the same, the ecological footprint would increase. That means improving the distribution of income among today's contemporaries, a good thing in itself, would worsen the economic prospects of future generations. There is a clash here between present

and future rights.

If ecological footprint increases more than proportionately with income, our conclusions are reversed: Equalizing incomes among contemporaries would improve the economic prospects of future generations, but an  $X$  per cent growth in global GDP would be accompanied by a more than  $X$  per cent growth in ecological footprint. Either way, the environmental consequences of growth and distribution point in opposite directions. That's another problem for the hapless policy maker.

To better appreciate the clash of rights that has been the focus of this paper, it pays to look at an extreme case:

In Niger the TFR is currently 7.6. It is estimated that only 12 per cent of married (or in union) women in the country use modern methods of contraception. But unmet need for family planning is low: under 17 per cent among married (or in union) women say they do not wish to get pregnant and are not using contraception. They also say their desired number of children is 9.5. Income per capita is 940 dollars (PPP), meaning that the *average* person there is not much above the internationally accepted level of absolute poverty (1.90 dollars (PPP)). The country's population in 2012 was 17.6 million and is projected to rise to over 72 million in 2050. It is more than just difficult to imagine what resources will be available for the millions who will be born there in the coming years. And yet, using reproductive rights as the ethical basis of family planning programmes in

Niger could even dictate that married (or in union) women there should be helped to raise their fertility rate. The clash of rights we have drawn attention to here is self-evident. The moral problems it raises are not easy to resolve. But that is no reason for avoiding them.