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HOW TO CONNECT BIOETHICS AND ENVIRONMENTAL ETHICS: HEALTH, SUSTAINABILITY, AND JUSTICE

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ABSTRACT
In this paper, I explore one way to bring bioethics and environmental ethics closer together. I focus on a question at the interface of health, sustainability, and justice: How well does a society promote health with the use of no more than a just share of environmental capacity? To address this question, I propose and discuss a mode of assessment that combines a measurement of population health, an estimate of environmental sustainability, and an assumption about what constitutes a fair or just share. This mode of assessment provides an estimate of the just and sustainable life expectancy of a population. It could be used to monitor how well a particular society promotes health within just environmental limits. It could also serve as a source of information that stakeholders use when they deliberate about programs, policies, and technologies. The purpose of this work is to focus attention on an ethical task: the need to fashion institutions and forms of life that promote health in ways that recognize the claims of sustainability and justice.

When Van Rensselaer Potter coined the term 'bioethics' in 1970, he had in mind a field of study that would bring together biological knowledge and ethical values.[1] He hoped this field would include broad issues about population health, acceptable survival, and the natural environment. But these broad issues received relatively little attention in the field of study that appropriated the name 'bioethics'. For the most part, bioethics focused on medical developments and ignored environmental issues.[2]

But the environmental issues are more serious and urgent than ever: unmitigated climate change, population growth that could reach nine billion, increased consumption of resources, shortages of fresh water, over harvesting of fish stocks, deforestation, erosion of cropland, and the extinction of species. In the face of these problems, we need to consider ways to bring environmental concerns back into ethical discussions about health and healthcare.

To do that, I want to explore some issues at the interface of health, the environmental, and justice. Consider two related but different questions:

1. How much health does a population get from one unit of environmental cost?
2. How well does a society promote health with the use of no more than a fair share of environmental capacity?

The first question is about efficiency or productivity. It calls for a descriptive analysis. The second question is about efficiency and justice. It calls for an analysis that combines descriptive and normative elements. I want to offer an analysis that addresses the second question.

An important ethical task is to construct institutions and modes of living that promote health in ways that

[1] V.R. Potter. Bioethics, the Science of Survival. *Perspect Biol Med* 1970; 14: 127–153; V.R. Potter. *Bioethics: Bridge to the Future*. 1971. New York: Prentice Hall; V.R. Potter. 1988. *Global Bioethics*. East Lansing, MI: Michigan State University Press.
[2] W.T. Reich. The Word 'Bioethics': the Struggle Over its Earliest Meanings. *Kennedy Inst Ethics J* 1995; 5 (1): 19–34.

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recognize the claims of sustainability and justice. I have often thought about that task and argued about what would contribute to progress. But I have felt the need for some way, even a rough or heuristic way, of assessing progress. Obviously, a mode of assessment is going to require three things: a measurement of population health, an estimate of environmental impact and environmental capacity, and ethical arguments or assumptions about what constitutes a just share.

In this paper, I discuss one mode of assessment. To begin, I briefly describe an important measure of population health: estimates of life expectancies. Then I explain the idea of an ecological footprint: an estimate of the amount of land and water that a population uses to produce goods and absorb wastes. I express this measure in terms of the number of earths required if everyone lived in a similar way. I assume that a just share of biocapacity is one earth. (Later I discuss the reasons behind this assumption.) Then I propose a new index. I divide the life expectancy of a population by its ecological footprint. If a population has a life expectancy of 80 years and an ecological footprint of two earths, then its new index is 40 years. I call this measure a just and sustainable life expectancy.

This mode of assessment could be used in a number of ways. It could be used to monitor how well a particular group or society promotes health within just environmental limits. It could serve as one source of information, among others, that stakeholders use when they deliberate about programs, policies, and technologies. And it could be used to focus more attention on win-win situations: ways to reduce environmental impacts that also increase life expectancy.

This mode of assessment, like any other, will have its limitations. It will only be as good as the measurements of population health that it uses, the estimates of environmental impact that it relies on, and the ethical assumptions that it makes. I will try to make these measurements, estimates, and assumptions explicit so that other people can examine them and offer better accounts. As our measurements, estimates, and assumptions improve, better work will be possible. But given the gravity of the environmental problems, I don't want to wait. Even work that relies on somewhat rough estimates and somewhat simple assumptions may serve as a heuristic device that directs attention to important issues. My purpose in this paper is to direct attention to some vitally important issues about health, sustainability, and justice.

LIFE EXPECTANCIES

Life expectancy is a familiar metric in both public health and political discourse. It is an estimate of the how many years, on average, a child born now can expect to live, given the mortality rates in the larger population. Table 1 lists the life expectancies in selected countries.[3]

Table 1. Life Expectancy

Country	*Life Expectancy*
Japan	82.6
Sweden	80.9
Canada	80.6
Costa Rica	78.2
Cuba	78.0
USA	78.0
United Arab Emirates	77.8
China	73.4
India	62.8
Cambodia	62.0
Côte d'Ivoire	52.5
Sierra Leone	40.4

This metric raises a number of issues, both by what it reveals and what it hides. It reveals the large inequalities in health prospects that exist between nations – a child born in Japan can expect to live twice as long as a child born in Sierra Leone. And that raises issues about what justice demands in terms of global health.[4] But because the metric is an average measure, it hides large inequalities within nations, and those inequalities also raise issues of justice.[5] But I want to focus on a different issue. The problem is that achievements in life expectancy may be associated with an unsustainable use of natural resources and an unsustainable production of wastes. In some cases, the good of a relatively long and healthy life expectancy may be connected to harm done to the environment and, indirectly, to other people, nations, or generations. To address that problem, we need an estimate of environmental impact.

ECOLOGICAL FOOTPRINTS

By living, we impact the environment. We breathe air, drink water, eat food, wear clothes, build houses, burn fuels, and produce wastes. Some of us take showers, drive cars, fly in airplanes, buy computers, and produce children. Even after death, the disposition of our bodies has an environmental impact.

[3] World Health Organization (WHO). 2008. *Life Table for WHO Member States, 2006*. Available at http://www.who.int/whosis/database/life_tables/life_tables.cfm [Accessed 15 Sept 2008].

[4] J. Dwyer. Global Health and Justice. *Bioethics* 2005; 19: 460–475.

[5] P. Braveman & E. Tarimo. Social Inequalities in Health Within Countries: Not Only an Issue for Affluent Nations. *Soc Sci Med* 2002; 54: 1621–1635; C.J.L. Murray et al. Eight Americas: Investigating Mortality Disparities Across Races, Counties, and Race-Counties in the United States. *PLoS Med* 2006; 3 (9): e260 doi:10.1371/journal.pmed.0030260.

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An ecological footprint is an image of these impacts and a mode of measuring them.[6] More specifically, an ecological footprint 'measures the amount of biologically productive land and water area required to produce the resources an individual, population, or activity consumes and to absorb the waste they generate, given prevailing technology and resource management.'[7] The ecological footprint of a population includes land for raising crops, pastures for grazing, forests for harvesting wood products, lakes and oceans for fishing, and land that is used for infrastructure.[8] It also includes the land and water that are needed to absorb wastes, including emissions of carbon dioxide. In many industrialized countries the carbon footprint is a large part of the overall ecological footprint.[9]

Since some land can produce more goods or absorb more wastes than other land, the footprint needs to be expressed in a common unit. It is often expressed in global hectares average (gha), that is, the number of hectares of land with average biological productivity. It can also be expressed in 'earths': the number of earths that would be required if everyone lived in that way, at that level of consumption. Since the Earth currently has about 1.8 gha per person, the footprint in earths is the footprint in gha divided by 1.8, rounded off to the nearest tenth. The ecological footprint in the United States, for example, is 9.6 gha per person; that is about 5.3 earths.

An ecological footprint is a metric that combines different environmental impacts, like fishing and burning coal, into a common unit of measurement. Combining different factors into a common measure always involves decisions about comparative weight and importance. When we measure wealth in a common currency, we combine things like land, factories, paintings, bonds, and even social and human capital. When we measure health in disability-adjusted life years, we take into account the effects that illnesses and injuries have on different abilities: seeing, thinking, moving, feeling, and so on.[10]

Table 2. Ecological Footprints

Country	*Footprint in gha*	*Footprint in earths*
Cambodia	0.7	0.4
Côte d'Ivoire	0.7	0.4
Sierra Leone	0.7	0.4
India	0.8	0.4
Cuba	1.5	0.8
China	1.6	0.9
Costa Rica	2.0	1.1
Japan	4.4	2.4
Sweden	6.1	3.4
Canada	7.6	4.2
USA	9.6	5.3
U.A.E.	11.9	6.6

The overall footprint depends on several factors: the total population, the patterns of production and consumption, the amount of biologically productive land available, and the productivity of that land. Population affects the footprint because as the population increases, the overall environmental impacts increase and the global hectares per person decrease. Patterns of consumption also affect the footprint. Consuming vegetables and grains usually has less impact than consuming beef, since cattle produce methane and raising cattle often uses large amounts of grain, water, and oil.[11] Walking and bicycling have less impact than driving cars and flying in airplanes. When the footprint is measured in gha, the measurement depends on how productive the land is. Increased desertification, degradation of pasture, or erosion of topsoil will decrease the productivity of the land, and thereby increase the measurement.

In the 1980s, the global ecological footprint began to exceed the amount of biologically productive land.[12] The global footprint is now about 2.2 gha per person, whereas the global capacity is about 1.8 gha per person: in other terms, we are using about 1.2 earths, even though we live on one Earth. By using natural capital faster than it can be replenished, we are incurring ecological deficits. But the overall global footprint conceals large differences between populations and between people. As a first step toward disaggregating the overall global footprint, Table 2 lists the per capita footprints in selected countries.[13]

This metric provides one way of comparing environmental impacts of individuals, countries, and regions. It also provides a way of tracking changes over time. If Sweden, for example, succeeds in reducing its carbon emissions and makes other changes, its footprint will decrease. If China, for example, continues its current rate and mode of industrialization, its footprint will increase.

[6] M. Wackernagel & W. Rees. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island, B.C., Canada: New Society Publishers; Global Footprint Network. 2008. *Ecological Footprint.* Available at www.footprintnetwork.org [Accessed 30 Oct 2008].

[7] World Wildlife Fund for Nature International, United Nations Environment Programme, World Conservation Monitoring Centre, Redefining Progress & Center for Sustainability Studies. 2006. *Living Planet Report 2006*. Gland, Switzerland: World-Wide Fund for Nature: 38.

[8] M. Wackernagel et al. 2002. Tracking the Ecological Overshoot of the Human Economy. *PNAS* 2002; 99: 9266–9271.

[9] World Wildlife Fund for Nature International, *op. cit.* note 6, pp. 14–15.

[10] J.A. Salomon et al. 2003. Quantifying Individual Levels of Health: Definitions, Concepts, and Measurement Issues. In *Health Systems Performance Assessment: Debates, Methods, and Empiricism*. C.J.L. Murray & D.B. Evans, eds. Geneva: World Health Organization: pp. 301–318.

[11] H. Steinfeld et al. 2006. *Livestock's Long Shadow: Environmental Issues and Options*. Rome: Food and Agriculture Organization of United Nations.

[12] Wackernagel et al., *op. cit*. note 7.

[13] Global Footprint Network, *op. cit*. note 5.

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The ecological footprint is an imperfect but useful tool. It does not account for all environmental impacts and all aspects of sustainability.[14] For example, it does not account very well for stresses on freshwater resources, at least at this point in its development.[15] But it is probably the best tool we have to account for the overall environmental impacts of individuals, populations, and countries. So I intend to use this tool to address the question that I posed about promoting health with a just share of the capacity of the natural environment.

JUST AND SUSTAINABLE LIFE EXPECTANCY

To focus attention on the need to promote health in ways that recognize the claims of sustainability and justice, I want to propose a new index. For now, I am going to assume that a just or fair share of biocapacity is an equal per capita global share, namely, one earth per person. I will discuss and try to justify this assumption in the next section. Assuming that every person or population is entitled to use a fair share of biocapacity, I want to consider how well societies promote health within that limit. So the new index is calculated by dividing life expectancy (in years) by the ecological footprint (in earths), when the ecological footprint is greater than one. If the ecological footprint is less than one, then the new index is simply the ordinary estimate of life expectancy. Because this index addresses the second question that I posed – the question about efficiency and justice – I call it a just and sustainable life expectancy.

If we wanted to address the first question that I posed – about efficiency alone – then we should dispense with the assumption about what constitutes a fair share, drop the cutoff of one, and simply divide the life expectancy by the ecological footprint, even when the ecological footprint is less than one. That would result in a measure of efficiency or productivity (in years per environmental unit). But that is not quite the question that I am trying to address in this paper. The cutoff of one earth is not an arbitrary point, but a marker of an assumption about an ethical entitlement. This cutoff serves to focus attention on a particular ethical question.

Table 3 lists the just and sustainable life expectancies in selected countries.

Table 3. Just and Sustainable Life Expectancy

Country	*Life Expectancy*	*Ecological Footprint (in earths)*	*Just and Sustainable*
Cuba	78.0	0.8	78
China	73.4	0.9	73
Costa Rica	78.2	1.1	71
India	62.8	0.4	63
Cambodia	62.0	0.4	62
Côte d'Ivoire	52.5	0.4	53
Sierra Leone	40.4	0.4	40
Japan	82.6	2.4	34
Sweden	80.9	3.4	24
Canada	80.6	4.2	19
USA	78.0	5.3	15
U.A.E.	77.8	6.6	12

This index is not meant to be an overall measure of justice in a society. A society with a good score may not be just in many important respects. It may have serious deficiencies in terms of honoring basic rights, providing equal opportunity, moderating inequalities, or ensuring respect for different groups.[16] The index simply measures how many life years a society gets from a fair share of biocapacity.

Nor is the index meant to be an overall measure of the sustainability of a society. A society with a good score might be unsustainable because it has social institutions that create certain kinds of desires or because it has political institutions that fail to respond to new problems. The index only takes into account the use of a globally sustainable amount of biocapacity.

Some of the results make intuitive sense. The United States, with its large carbon footprint and high rate of consumption, only measures 15 years per just and sustainable share. Costa Rica, with its much smaller footprint and its emphasis on public health and primary care, measures 69 years per just and sustainable share. But some of the results may seem surprising, even anomalous. China, for example, measures 73 years. Several factors explain this result. The footprints of goods that are manufactured in China are assigned to the consuming countries, as they should be, even though the pollution associated with the production may be felt most in China. Also, although China now measures well, there are reasons to be concerned about its air pollution, water resources, rapid industrialization, and limited national biocapacity.[17]

This index could be used in many ways. It could be used to monitor trends and to track how well societies promote health within global environmental limits. The results show that some societies have been able to achieve

[14] Wackernagel et al. *op. cit*., note 7.

[15] World Wildlife Fund for Nature International, *op. cit*. note 6, pp. 12–15.

[16] J. Rawls. 1971. *A Theory of Justice.* Cambridge, MA: Harvard University Press; J. Rawls. 2001. *Justice as Fairness.* Cambridge, MA: Harvard University Press.

[17] E.C. Economy. 2005. *The River Runs Black: the Environmental Challenge to China's Future.* Ithaca, NY: Cornell University Press; World Watch Institute. 2006. *State of the World 2006*. New York: W.W. Norton.

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relatively long life expectancies at relatively low environmental cost. That is a great accomplishment. The index could also be used as one source of information, among others, that stakeholders use when they deliberate about programs, policies, and technologies. Although this index provides valuable information and adds perspective, it would probably be foolish to use this index, or any other, as an algorithm to decide complex ethical and political questions. The purpose of this simple index is to promote, not to substitute for, deliberation and reflection among all the stakeholders.[18]

The index could also be used to focus more attention on win-win situations: ways to reduce environmental impacts that also increase life expectancy. For example, by designing cities so that people walk or bicycle more, many societies could reduce their ecological footprints and increase life expectancies. Or, by reducing the consumption of meat and encouraging a plant-based diet, many societies could reduce their ecological footprints and increase life expectancies. If used with good sense and judgment, the index may help societies to fashion institutions that promote health in ways that take into consideration issues of sustainability and justice.

ASSUMPTIONS AND VARIATIONS

In my work, I made a number of simplifying assumptions. I assumed that a just or fair share of the Earth's biocapacity is an equal global share, namely, 1.8 gha per person. But is this assumption justified? We could, of course, make other assumptions. Instead of viewing biocapacity as a global endowment with global responsibilities, we could view it as a commodity to be owned, used, and traded by individuals and corporations, without regulation. But we know that markets often externalize environmental costs, especially the costs to future generations.

We could view the use of biocapacity as a matter for each sovereign nation to regulate. But here again we run into a similar problem. The footprint of a nation-state can be displaced across borders and across generations. Part of the United States' footprint is manifest as air pollution in China. Part of Japan's footprint is manifest as logging in Indonesia. This displacement is most apparent in carbon emissions and climate change. Since the effects of carbon emissions go beyond national borders and the current generation, and since the atmosphere is not a human artifact that one group worked to create, it is hard to justify a claim for an unequal share of the atmosphere's capacity to act as a carbon sink.[19]

Although I want to encourage nation-states to act as responsible stewards of the biocapacity within their borders, I also see the need to set global limits. A simple and plausible way to think about a global limit is to begin with an equal per capita share. From an ethical perspective, equality is a good place to start.[20] It often reflects a form of respect, a recognition of common vulnerabilities, equal basic rights, duties not to harm others, and claims on the global commons. What needs justification is not this starting place, but unequal claims that might be based on appeals to need, desert, responsibility, and sovereignty. We could try to take into account differences among nations in heating needs, cooling needs, infrastructure, past development, population growth, and so on. But soon this becomes unworkable, with no apparent gain in justice. The assumption about an equal per capita global share of biocapacity is a simple but plausible assumption. However, I would be the first to admit that this whole subject merits more discussion than I can give it in this paper.

Since I assumed that a fair share is an equal per capita global share, I should also take into account the inequalities *within* nations. The ecological footprints of people within a given country vary because of differences in consumption, lifestyle, income, and wealth. And these differences raise issues of social justice. I have not addressed these issues because I do not know of good datasets on differences in footprints of people within nations. When we have better data, we could begin to address issues of justice within nations. One approach to these issues would examine, at one stage, the consumption patterns and footprints of all people in the world. Another approach would use two stages: first to examine the consumption patterns and footprints of countries, and then to ask countries to examine and address the differences within their population. These approaches raise complex questions about how much ethical meaning political borders have and whether an account of justice should be more cosmopolitan or more political.[21] This paper is merely a first step, not a complete approach.

In my work, I made a second simplifying assumption. I assumed that a reasonably long life expectancy is a good thing. That is not a very controversial assumption. What

[18] A. Gutmann & D. Thompson. 1996. *Democracy and Disagreement*. Cambridge, MA: Harvard University Press; N. Daniels & J. Sabin. 2002. *Setting Limits Fairly.* New York: Oxford University Press.

[19] P. Singer. 2002 One World: the Ethics of Globalization, 2nd edn. New Haven, CT: Yale University Press: 14–50; P. Baer, T. Athanasiou, & S. Kartha. 2007. The Right to Development in a Climate Constrained World: the Greenhouse Development Rights Framework. Available at www.ecoequity.org/docs/TheGDRsFramework.pdf [Accessed 1 Oct 2008].

[20] J. Rawls, *op. cit.* note 15; P. Singer. 1993. *Practical Ethics*, 2nd edn. New York: Cambridge University Press.

[21] Dwyer, *op. cit.*, note 4.

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is more controversial is the decision to use life expectancy instead of another measure. Instead of life expectancy, one could use a measure of healthy life expectancy, human development,[22] or even happiness.[23] Many variations are possible, depending on the assumptions that one makes about justice and the measure of goodness that one chooses. I chose life expectancy because it is a familiar and useful measure of health prospects. In many contexts in which one uses life expectancy, one could also consider just and sustainable life expectancy in order to bring environmental costs into the discussion. But I don't want to claim that life expectancy is the best measure to use for all purposes. The best measure to use probably depends on the particular purpose.

[22] Human Development Reports. 2008. *Questions About the Human Development Index*. Available at http://hdr.undp.org/en/statistics/faq/ [Accessed 15 Oct 2008].
[23] Happy Planet Index. 2008. *The Happy Planet Index*. Available at www.happyplanetindex.org. [Accessed 15 Oct 2008].

THE ETHICAL TASK

The word 'index' comes from the Latin name for the forefinger, the one we use in pointing. I constructed an index of a just and sustainable life expectancy in order to point to an ethical task: the need to fashion institutions and forms of life that promote health in ways that recognize the claims of sustainability and justice. I hope that my work serves to direct attention to this task.

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