A Research Agenda to Examine Ecological Footprint Impacts on Economic Performance

Mathis Wackernagel[1], Kyle Gracey[1,*], Gemma Cranston[2], Alessandro Galli[2], Juan Carlos Morales[1]

[1]Global Footprint Network, 312 Clay Street, Suite 300, Oakland, CA 94607-3510, USA
[2]Global Footprint Network, International Environment House 2, 7-9 Chemin de Balexert, 1219 Geneva, Switzerland

*Corresponding author:
Kyle Gracey
Tel: +1 (510) 839-8879 x315
Email: Kyle@footprintnetwork.org

Abstract

We present a research agenda, and some preliminary tools and results, to investigate whether and how changes in a country's Ecological Footprint may result in changes to national economic performance. Current applications of the Ecological Footprint methodology provide a way to calculate the quantity and human use of biological capacity (biocapacity), but the methodology provides no direct link to whether or how this use affects economic performance of nations. If such a link can be validated, it could give nations a new tool to improve national economic performance and serve as a way to buffer their economies against the monetary impacts of resource depletion or rapid resource price increases.

First, a method for assessing the economic value of a country's biocapacity deficit or biocapacity remainder may help to illuminate the embedded economic cost of nations using more biocapacity per capita than is available domestically. This is accomplished by calculating the quantity of each land type in a country that is in ecological deficit, and multiplying these deficit quantities with world market prices of related resources (timber, fossil fuels, crops, etc.) to arrive at total cost of country biocapacity deficit. In general, real prices for biocapacity per person have been rising over time, particularly in the past decade.

These results are compared to each country's Gross National Income (GNI) per capita in the same years, to give a sense of how large each cost of biocapacity deficit compares to per person earnings.

Results suggest that, on average, citizens face a cost of biocapacity deficit that is about one-fifth of their GNI. In a few cases, the cost is nearly 100% of GNI. The relatively rapid rise in carbon Footprints and fossil fuel prices may mean that deficits due to Carbon will be particularly expensive. However, approximately one-third of all nations pay no costs because they do not have biocapacity deficits.

Still, many potential refinements to the methodology may exist. Prices may instead be calculated as a single world average price per global hectare. Values for minerals and water may also be included. A wider range of crops could be considered. Deficits costs could be valued individually for each land use type. Statistical testing may be needed to see if these expected costs have actually impacted national economies as they have risen or fallen.

These and other potential improvements are already under active investigation.

Introduction

Calculation of the availability of biological capacity (biocapacity) and human use of this biocapacity, using the well-known Ecological Footprint methodology, has been documented previously (Ewing, et al. 2010). Using this methodology, the condition known as biocapacity deficit occurs when human use of biocapacity (called Ecological Footprint) within a fixed area of the world exceeds the available biocapacity within that same area (often a country, or the world) over the course of one year (Kitzes, et al. 2008). This is also known as an ecological deficit (Ibid). The opposite condition, when local biocapacity exceeds local Ecological Footprint, is termed biocapacity reserve or ecological reserve (Ibid).

However, little research has sought to quantify the impact of biocapacity deficit on a country's economic performance. On partial exception – Mattila (2012) used structural decomposition in the Finnish economy to show that activity in sectors of the economy that most drove Gross Domestic Product growth differed in most cases from those sectors that contributed most to growth in Ecological Footprint, but did not directly analyze the impact of Ecological Footprint growth, especially in comparison to locally available biocapacity, on economic growth.

Further, the Ecological Footprint methodology provides no direct link since it does not incorporate the prices or other economic properties of the biocapacity it accounts for. However, these resources have prices when they are consumed in the market, and they serve as intermediate and final goods that contribute to economic growth. If the prices for types of biocapacity, such as forest products or crops, increase, these additional costs will either mean additional revenue for countries that can export them, or additional costs for countries that must import them. In extreme cases, where biocapacity resources become depleted to the point that they cannot be consumed at the level desired by a country's residents, or consumed at all, this supply shock could also significantly affect economic health, especially in comparison to countries that are consuming resources at a rate that is below what they can regenerate within their own boundaries.

If a method for linking biocapacity deficits and associated economic impacts can be validated, it would give nations a new tool to improve their economic performance. We present the beginnings of a research agenda to explore these impacts, including an initial tool, preliminary findings, a discussion of strengths and weaknesses of this initial work, and brief explanations of future research.

Materials and Methods

First, we introduce the concept of the cost of biocapacity deficit and then construct a simple set of equations to arrive at a first approximation of its value. Potential improvements to this approximation are discussed in Conclusion. Cost of biocapacity deficit is the monetary value of that portion of a country's yearly Ecological Footprint that exceeds the yearly biocapacity within its geographic borders. It can be thought of as a tool to convert Ecological Footprint values, measured in global hectares (gha) (Kitzes, et al. 2008), into units of currency. In this application, it specifically measures the economic value of national biocapacity deficits, rather than the economic value of the entire Ecological Footprint of a nation.

Biocapacity Deficit

Using data from Global Footprint Network's National Footprint Accounts 2010 Edition (which contains data for 1961 through 2007), the biocapacity deficit per capita of each land use type (cropland, grazing, fishing grounds, forest land, and carbon) is calculated, following the methodology of (Ewing, et al. 2010), for 222 countries, territories, and former countries, plus the world – these are listed in Appendix 1.

If the sum of these deficits is less than or equal to zero, then no deficit exists in this country and year, and thus the cost of the deficit is zero. Otherwise, a total deficit is calculated for that country and year.

Only the costs of those land types that are in deficit will contribute to an overall cost of biocapacity deficit. However, the total deficit calculated includes contributions from all land use types (positive values for deficits and negative values for biocapacity reserves). To account for this, the total deficit is apportioned to each land use type in deficit based on its relative contribution to this total deficit. Table 1 provides an example of this reweighting for Costa Rica in 2007:

Cropland	Grazing land	Fishing Grounds	Forest land	Carbon	Total	Cropland	Grazing land	Fishing Grounds	Forest land	Carbon

Table 1: Sample reweighting of biocapacity deficits (Costa Rica in 2007). For example, Carbon Footprint contributed 83.6% of the total biocapacity deficit. This equals 0.66 gha/cap out of a total deficit of 0.79 gha/cap.

Prices of Land Use Types

Next, the average price, in United States dollars, is calculated for each gha of each land use type. The calculation for each land use type is discussed in each of the following subsections.

<u>Cropland</u>

Equation 1 describes the calculation for Cropland price in a given year:

$$Average\ price\ per\ global\ hectare\ (Cropland) = \frac{\sum_i \left(\left(\frac{p_i * Y_i}{EQF_C} \right) * \left(\frac{P_i * EQF_C}{Y_i} \right) \right)}{\sum_i \left(\frac{P_i * EQF_C}{Y_i} \right)} \qquad (1)$$

where i = 5 representative crops: soybeans, maize, U.S. wheat, rice, and palm oil

p = price per ton of crop, constant 2005 US dollars (World Bank, The 2012)

Y = world average yield (ton/world average hectare) of crop (Food and Agriculture Organization of the United Nations 2012)

EQF_C = current equivalence factor for Cropland, 2.51 (Global Footprint Network 2011)

P = production (ton) of crop (Food and Agriculture Organization of the United Nations 2012)

Here, the first equation in parentheses in the numerator calculates the price per global hectare for each crop, while the second equation in the numerator calculates the total number of global hectares for each crop.

<u>Grazing land</u>

Equation 2 describes the calculation for Grazing land price in a given year:

$$Average\ price\ per\ global\ hectre\ (Grazing\ land) = \frac{\left(\frac{\sum_i (E_i * p_i)}{\sum_i E_i}\right)}{\left(\frac{\sum_i (E_i * G_i)}{\sum_i E_i}\right)} \quad (2)$$

where E = export quantity of the commodity in tons (Ibid)

p = export price of the commodity per ton in constant 2005 US dollars (Ibid)

G = grass feed requirement (gha per ton dm) (Global Footprint Network 2011), constant across years

and the basket, i, of livestock used for weighting contains 7 common livestock types that consume grass feed, from FAOSTAT (2012).

Similar to Equation 1, the equation in parentheses in the numerator is the export quantity-weighted average price ($/t), and the equation in parentheses in the denominator is the export quantity-weighted average feed intensity (gha/t).

<u>Fishing grounds</u>

Equation 3 describes the calculation for Fishing grounds price in a given year. All values come from FAO FishStat (2012) and Global Footprint Network's National Footprint Accounts (2011):

$$Average\ price\ per\ global\ hectare\ (Fishing\ grounds) = \frac{\left(\frac{\sum_i (E_i * p_i)}{\sum_i E_i}\right) * \left(\frac{\sum_i (E_i * Y_i)}{\sum_i E_i}\right)}{EQF_F} \quad (3)$$

where i = 130 fish commodities

E = export quantity of the commodity in tons

p = export price of the commodity per ton in constant 2005 US dollars

Y = yield in tons/world average hectares of the commodity (assumed constant over time per commodity)

EQF_F = equivalence factor for Fishing grounds (varies per year in the range of 0.365-0.371)

Similar to Equations 1 and 2, the first equation in parentheses in the numerator is the export quantity-weighted average price ($/t), while the second is the export quantity-weighted average yield (t/wha).

<u>Forest land</u>

Equation 4 describes the calculation of Forest land price in a given year. It is similar to Equation 3. Data come from FAO ForesStat (2012) and Global Footprint Network's National Footprint Accounts (2011):

$$Average\ price\ per\ global\ hectare\ (Forest\ land) = \frac{\left(\frac{\sum_i (I_i * p_i)}{\sum_i I_i}\right) * \left(\frac{\sum_i (I_i * Y_i)}{\sum_i I_i}\right)}{EQF_R} \quad (4)$$

where i = 10 primary FAOStat forest commodities

I = import quantity of the commodity in tons

p = price of the commodity in constant 2005 US dollars

Y = yield in tons/world average hectares of the commodity (varies per year)

EQF_R = equivalence factor for Forest land (varies per year in the range of 1.26-1.28)

<u>Carbon</u>

Carbon is the currently the only pricing equation to take into account the country-specific consumption of commodities each year. It is shown as Equation 5 for the price in one year. Prices come from the World Bank (2012), fossil fuel consumption from the International Energy Agency (2011), conversion factors from the Environmental Protection Agency (2007), and the Footprint Intensity of Carbon from Global Footprint Network National Footprint Accounts (2010):

$$Average\ price\ per\ global\ hectare\ (Carbon) = \sum_i \left(\frac{p_i}{c_i * F} * f_i\right) \quad (5)$$

where i = crude petroleum (bbl, West Texas Intermediate), Australian coal (mt), or US natural gas (mmbtu)

p = world price of the fossil fuel in constant 2005 US dollars per unit

F = Footprint Intensity of Carbon ≈ 0.1858 gha/Mt CO_2/year

f = country-specific fraction of domestic consumption of fossil fuel i out of total country-specific domestic consumption of all 3 fossil fuels

c = conversion factor for fossil fuel i:

1 bbl petroleum ≈ 0.43 t CO_2

1 mt (anthracite) coal ≈ 2.12 t CO_2

1 mmbtu natural gas = 0.0546 t CO_2

Cost of Biocapacity Deficit

The total cost of the biocapacity deficit for a given country in a given year is then simply:

$$Cost\ of\ biocapacity\ deficit = \sum_i (d_i * p_i) \tag{6}$$

where i = the 5 land use types

d = the reassigned deficit/capita for each land use type, as exemplified in Table 1

p = average price/gha as calculated in Equations 1-5

Comparison to Total Economy – Gross National Income

To compare the cost per person of the biocapacity deficit to the average monetary wealth available to each citizen in a nation, the gross national income (GNI) per person (World Bank, The 2011) in constant 2000 US dollars serves as a reference value. GNI is chosen over gross domestic product because it more closely represents the economic activity within a nation's borders, similar to the way in which local biocapacity deficits account for natural resource consumption that is beyond what is available within those same national borders.

Results

Tables 1-5 display the world average cost per gha for each land use type, based on Equations 1-5. For Carbon, the world average fossil fuel mix is used. In all cases, prices have tended to increase over time, even when measured in constant dollars, especially in recent years. Fishing grounds prices have usually been the highest in any given year, while Cropland and Carbon prices have increased the fastest in the past three to four years.

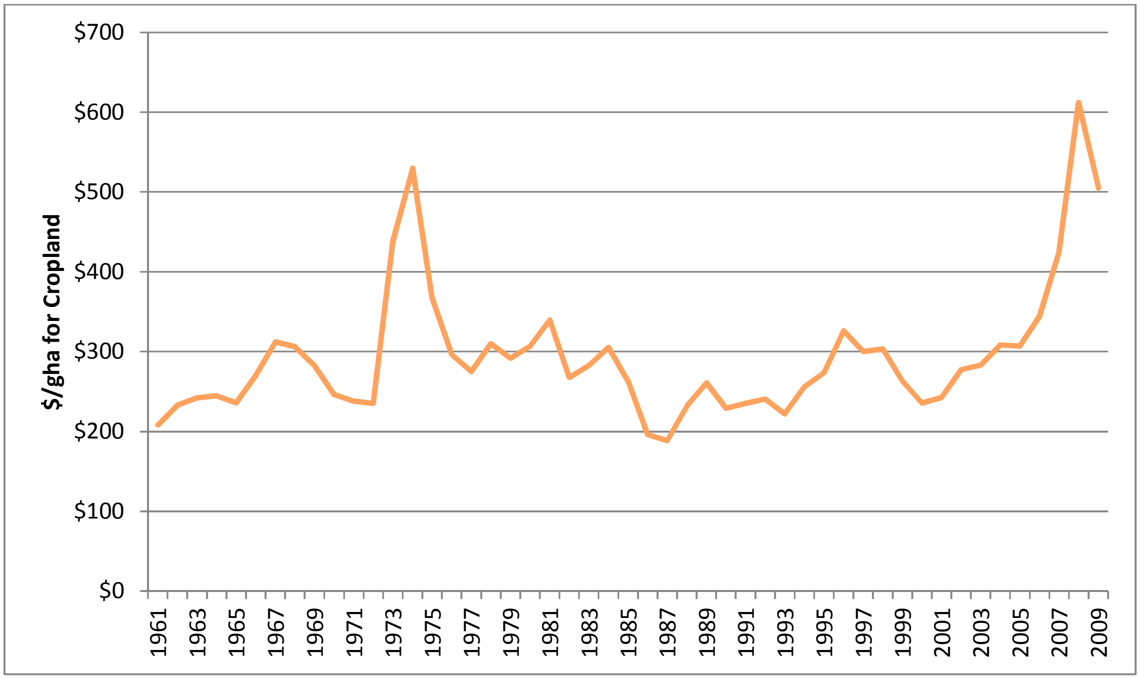


Figure 1: World Average Annual Price per Global Hectare for Cropland (constant 2005 US dollars)

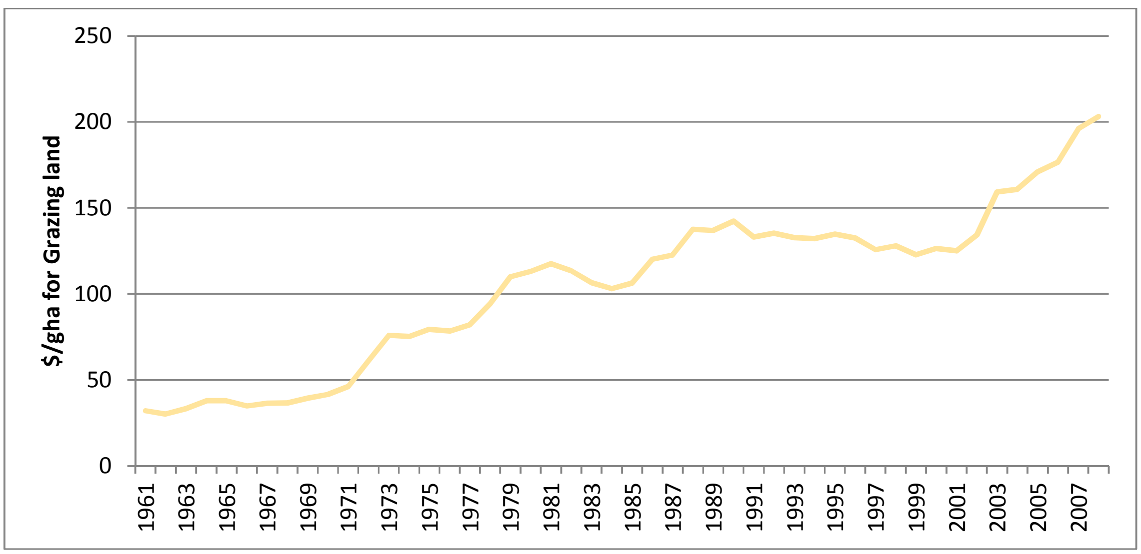


Figure 2: World Average Annual Price per Global Hectare for Grazing land (constant 2005 US dollars)

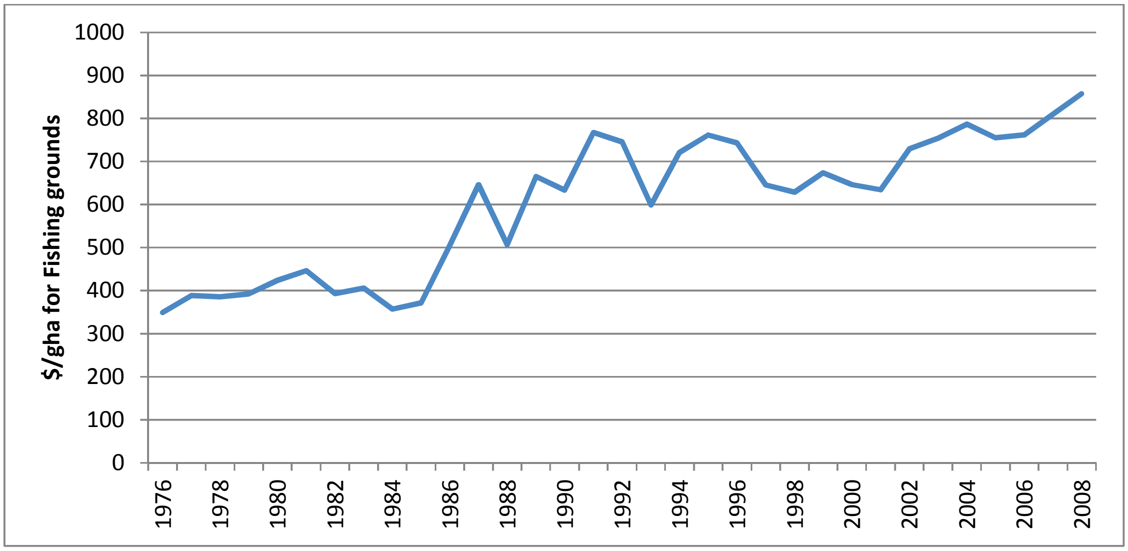


Figure 3: World Average Annual Price per Global Hectare for Fishing grounds (constant 2005 US dollars)

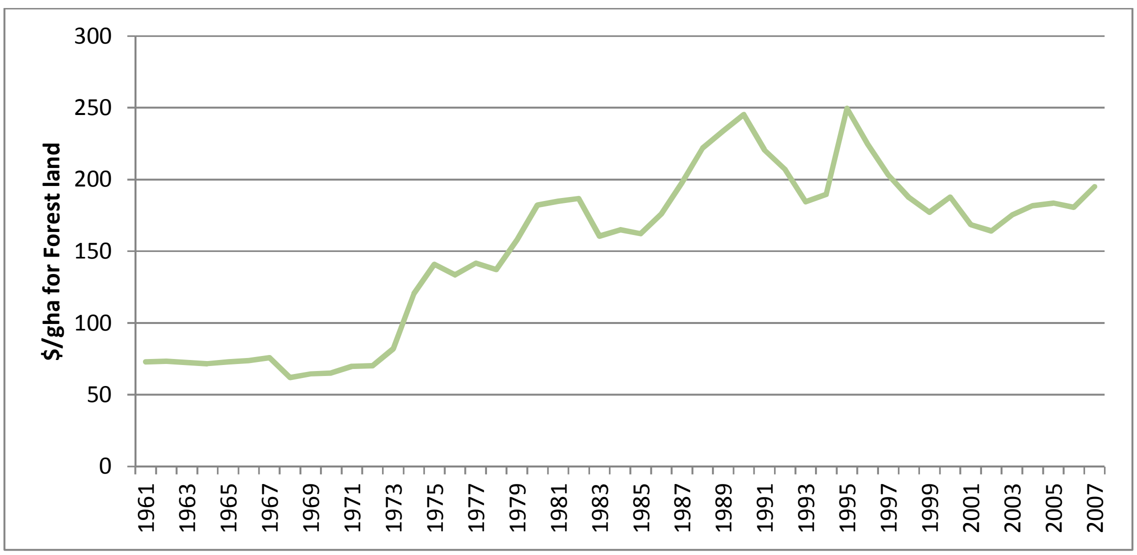


Figure 4: World Average Annual Price per Global Hectare for Forest land (constant 2005 US dollars)

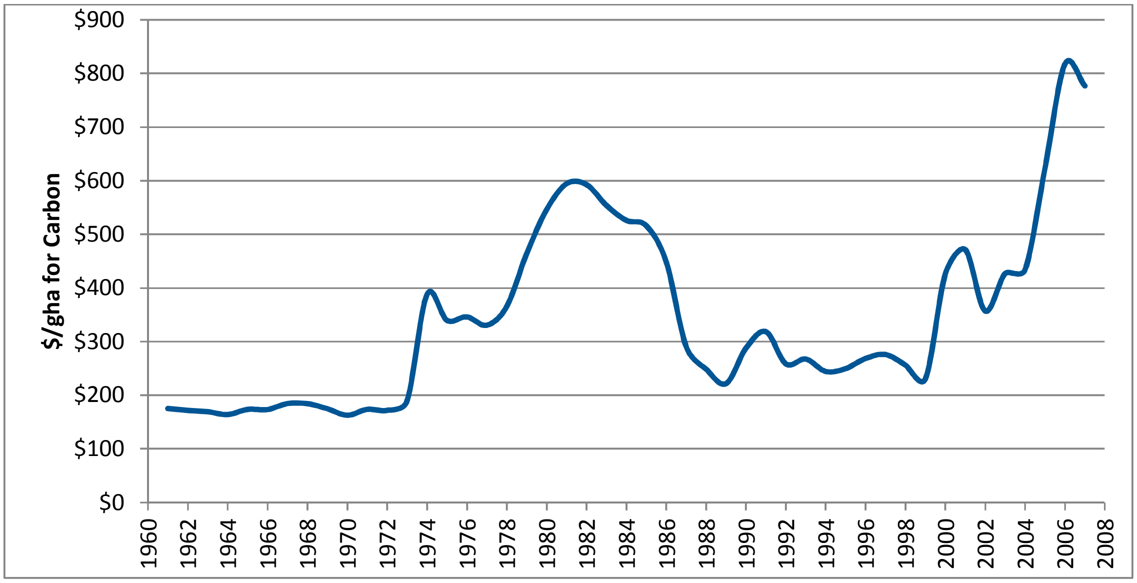


Figure 5: World Average Annual Price per Global Hectare for Carbon (constant 2005 US dollars)

Similar to the results in Table 1, 132 countries and territories had an overall biocapacity deficit in 2007. Table 2 presents summary statistics when these deficits (including zero deficits) are multiplied by the prices for global hectares in 2007, as in Equation 6. In 110 of these countries and territories, the cost per person of Carbon exceeds the combined cost per person of all other biocapacity deficits, so the land use types are combined into "Non-carbon" and "Carbon"[1]. On average, these costs represent nearly a fifth of per person national income, though they vary widely across nations[2].

	Non-Carbon	Country	Carbon	Country	NC+C	Country
Maximum	$1,485.51	Gambia[3]	$6,114.95	Bahrain	$6,754.29	U.A.E.[1]
Average	$ 366.62		$732.89		$1,099.51	
Standard Deviation	$1,877.32		$1,72.25		$2,516.52	
% of GNI[4], Max[5]	61.5	Uganda	79.3	Zimbabwe	91.5	Zimbabwe
% of GNI, Average	3.7		13.9		17.6	
% of GNI, Std. Dev.	8.0		16.6		20.4	

Table 2: Summary statistics of per person cost of biocapacity deficits for 2007. "NC+C" is non-carbon plus carbon.

[1] All forms of biocapacity are carbon-based. In this paper, the term "Carbon" is meant to refer to fossil carbon, while "Non-Carbon" refers to non-fossil carbon.

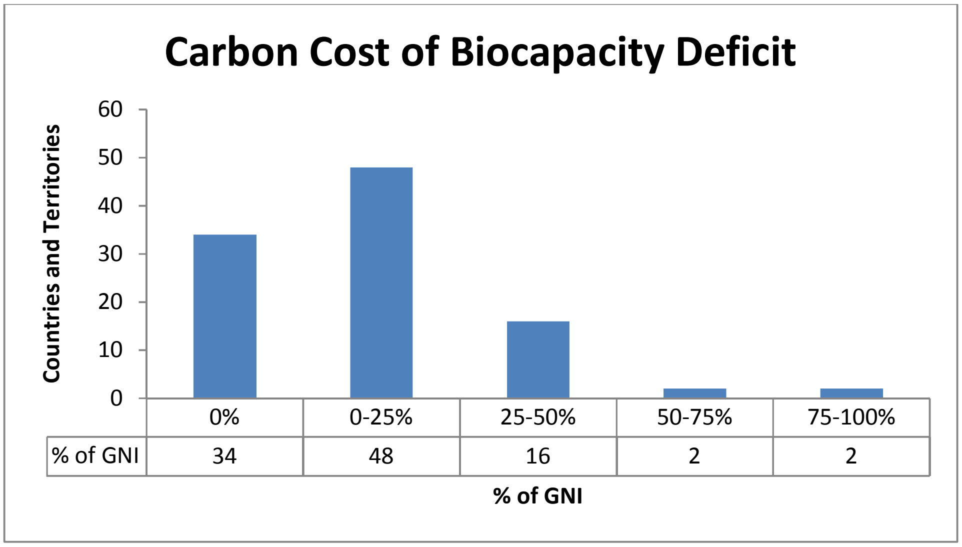
[2] In Seychelles and Tajikistan, the cost of biocapacity deficit appeared to exceed GNI, and these two values are not included in the statistics.

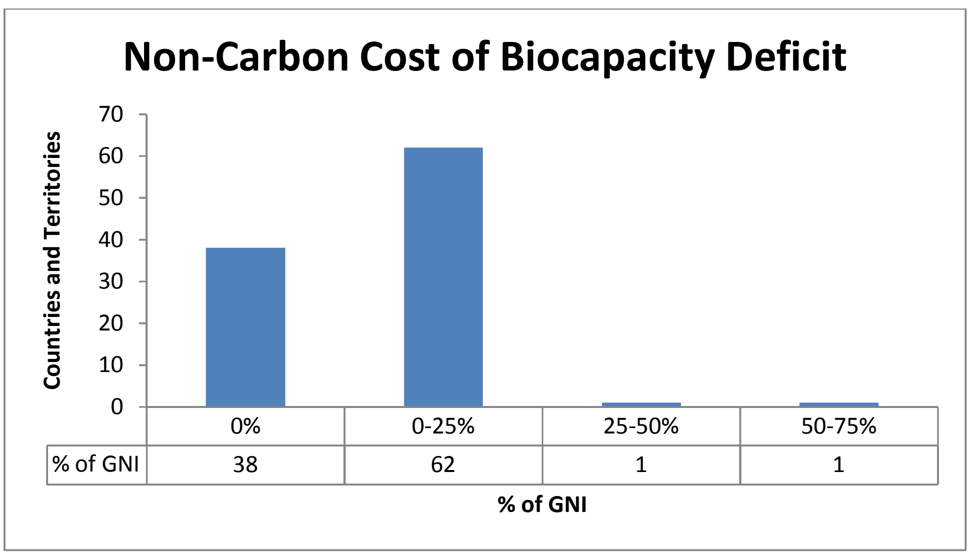
[3] Largest for a country with more than 1,000,000 people, a common Global Footprint Network National Footprint Accounts standard for data quality (2011). Several island nations with fewer than 1,000,000 inhabitants have higher values, in some cases exceeding their GNI per person, but these may be due to lower data quality.

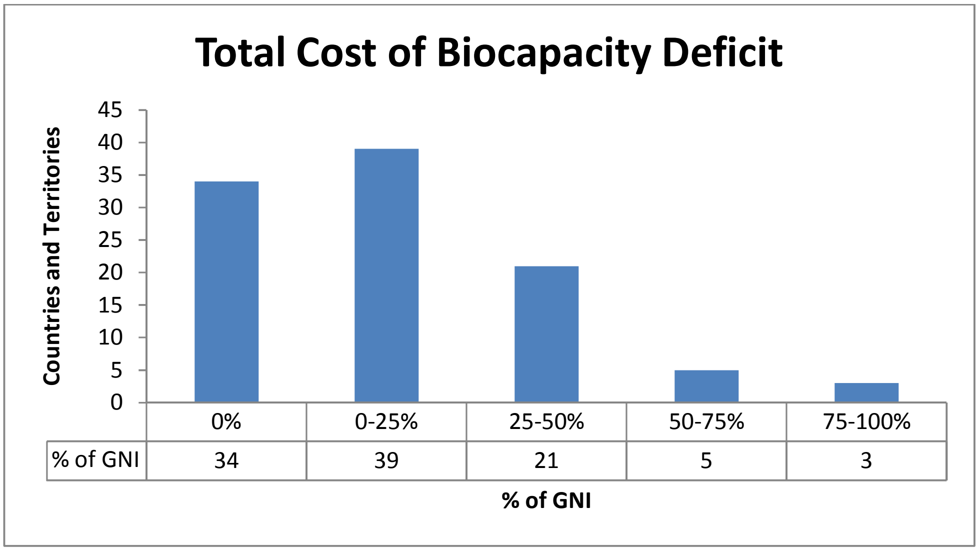
[4] For 117 countries and territories, no GNI per person was available and these were excluded from the calculations.

[5] Where the total cost of biocapacity deficit per person did not exceed GNI per person.

Figure 6-8 present histograms of the cost of biocapacity deficit deficits as percentages of GNI for all countries and territories where GNI in 2007 was available, for carbon, non-carbon, and carbon plus non-carbon (total). Most are either zero (where there is no biocapacity deficit, or in the range of zero to twenty-five percent of GNI.

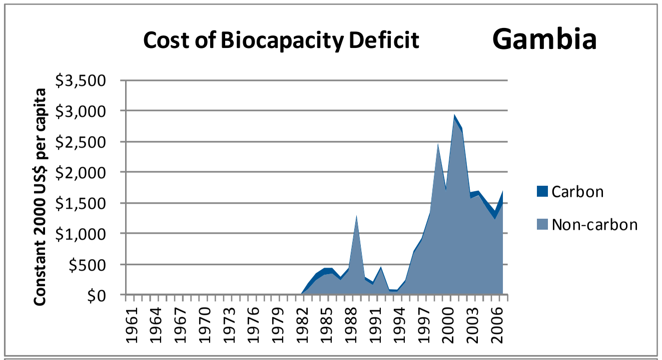


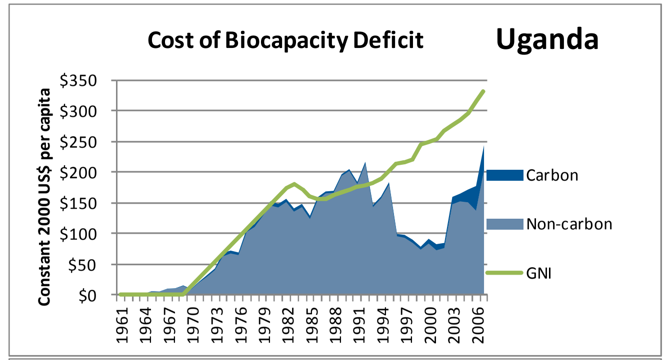


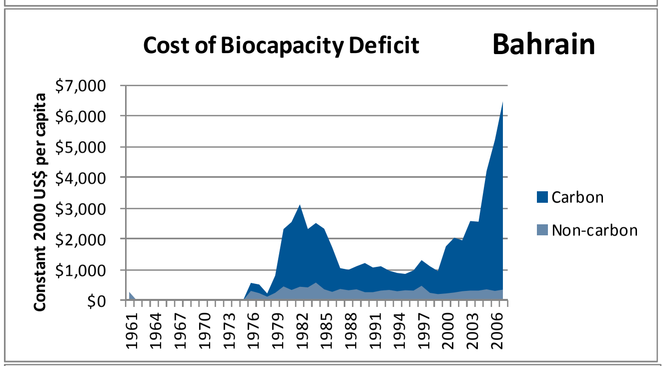


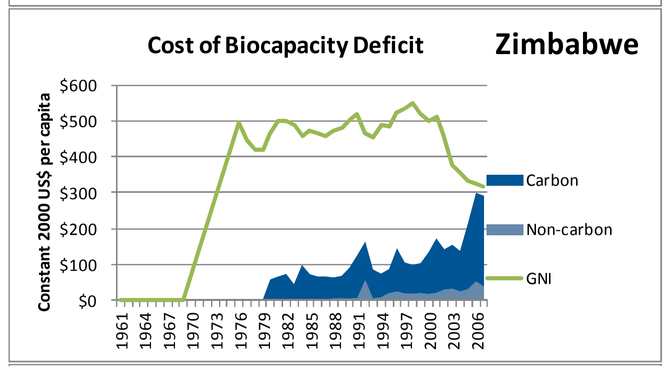
Figures 6-8: Histograms of the carbon, non-carbon, and total (carbon plus non-carbon) cost of biocapacity deficit for countries and territories in 2007 as a percentage of their respective GNI.

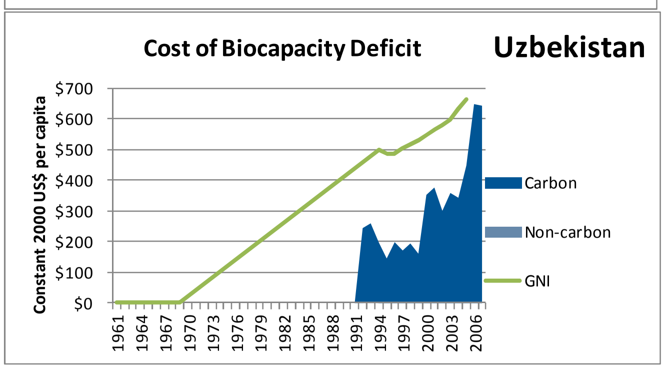
Figures 9-16 present time series for eight example countries, chosen to illustrate some of the diversity of cost of biocapacity deficits found in the full results:

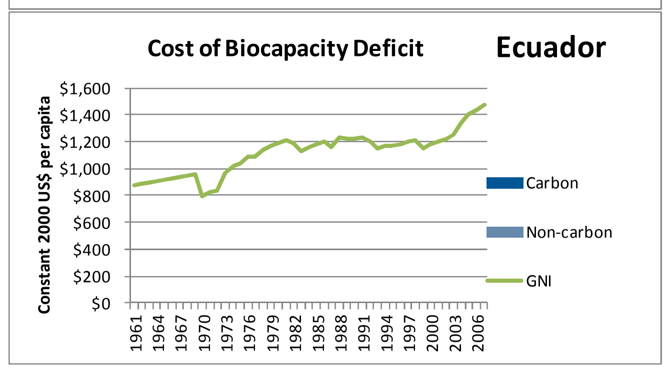

Cost of Biocapacity Deficit
Gambia
Constant 2000 US$ per capita
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon

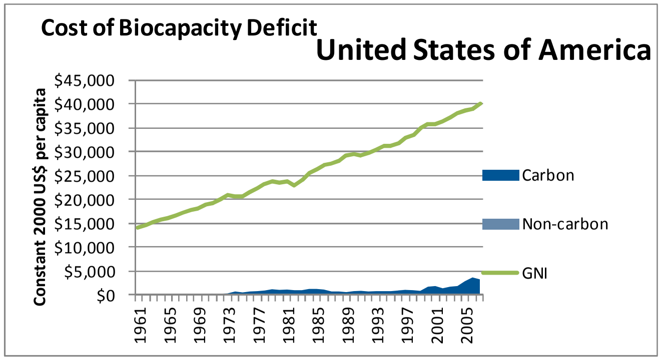

Cost of Biocapacity Deficit
Uganda
Constant 2000 US$ per capita
$350
$300
$250
$200
$150
$100
$50
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon
GNI

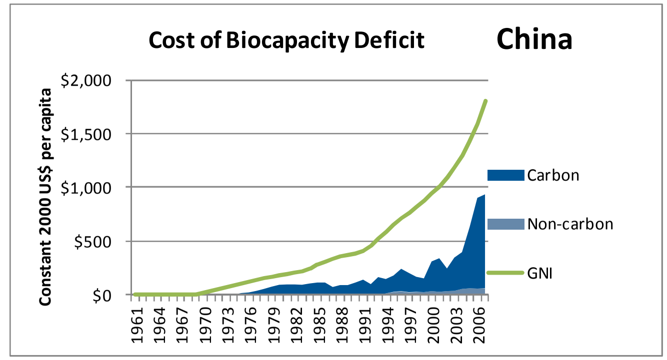

Cost of Biocapacity Deficit
Bahrain
Constant 2000 US$ per capita
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon


Cost of Biocapacity Deficit
Zimbabwe
Constant 2000 US$ per capita
$600
$500
$400
$300
$200
$100
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon
GNI


Cost of Biocapacity Deficit
Uzbekistan
Constant 2000 US$ per capita
$700
$600
$500
$400
$300
$200
$100
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon
GNI


Cost of Biocapacity Deficit
Ecuador
Constant 2000 US$ per capita
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Carbon
Non-carbon
GNI





Tables 9-16: Time series of example countries, showing carbon and non-carbon cost of biocapacity deficit per capita compared to (where available) GNI per capita. Vertical scales are not equal. Earlier years of data are not available for some countries.

Discussion

The data suggest that biocapacity deficits represent real costs to nations' economies. On average, they were nearly a fifth of economic spending in 2007, and in some cases nearly 100%. Nearly 33% of countries with GNI data for 2007, however, did not pay any cost because they had biocapacity reserves. Biocapacity deficits can only be achieved by consuming resources from abroad (Kitzes, et al. 2008). For nations dependent upon these resources, if they become scarce in the future or their prices increase, meeting this need may require forgoing other expenditures, going (further) into monetary debt, or losing whatever value these resources have to citizens and future economic productivity by doing without.

Increasing costs from biocapacity deficits appear likely, as the prices per gha for these land use types have tended to increase over time, as shown in Figures 1-5, and National Footprint Accounts (2011) data show that biocapacity deficits have also tended to increase over time. Sharply rising fossil fuel prices, coupled with the tendency of nations to have larger (and faster growing) carbon Footprints than other Footprints (Ibid) also indicate that nations with relatively larger fossil fuel consumption compared to other types of consumption will be particularly affected if these trends continue. Current energy use forecasts indicate that they will (International Energy Agency 2011).

Irrespective of international and multilateral efforts to conserve biological resources and limit greenhouse gas pollution, these prices suggest that it may be in nations' economic self-interests to keep their consumption of biocapacity to within the limits of what is domestically available.

However, there is much these prices do not indicate. The information indicates the prices of these assets on the world market. It does not necessarily show what each country locally pays to acquire biocapacity from abroad, since not every nation pays world market prices for all goods and services.

The prices may also bias the real monetary values of these biocapacity deficits if they do not fully reflect the basket of goods and services embedded in each land use type. For example, the full range of fossil fuel types, and their associated, unique costs, are not calculated, and this may not reflect the costs of refined fossil fuel products that some of this Carbon biocapacity deficit contains. Similarly, the representation of Cropland costs relies on only 5 primary crops. This simplification was intentional, to attempt to capture only the value of the natural system that produces the resource, though another option would be to include the labour and capital costs necessary for converting these resources into economic goods. The pricing data, and the National Footprint Accounts, also do not disaggregate varying prices and Ecological Footprints for forest products from different species, which may bias results for countries with Forest land deficits in particularly high- or low-value species.

Nonetheless, this research provides a first approximation of the quantitative impact on national economies from using more biocapacity each year than is available domestically, and suggests that these costs, and thus impacts, are large and growing for many nations, relative to the sizes of their overall economies. The very definition of a cost of biocapacity deficit also suggests that countries can realize cost savings by avoiding biocapacity deficits. Much work remains to improve the resolution and accuracy of this novel valuation tool. The final section articulates a series of research initiatives to begin accomplishing this.

Further Work

The current methodology only considers a country to face costs of biocapacity deficit if there is an overall biocapacity deficit across the sum of all land use types, and then assigns this deficit proportionally across those land use types that are in deficit individually. Another approach would be to value each deficit uniquely, and to count the cost of any land use type that is in deficit, even if the country as a whole does not experience a biocapacity deficit in a given year. On the one hand, this ignores the ability of nations to substitute one type of biocapacity for another – consuming more livestock (Grazing land) instead of seafood (Fishing grounds). On the other hand, not counting each deficit individually treats all land use types as fungible, when in fact a deficit in one, say Forest, cannot necessarily be substituted for with a surplus in another, say Cropland, since, in this case, both land use types are not capable of providing the same good, say food, that economies depend on.

More fundamentally, there is the question of whether each land use type should have an independent cost determined, or whether, given that all land use types can be expressed in the common unit of global hectares, the costs could also be uniformly represented as a single price for each global hectare of biological regenerative capacity.

The costs of using several other, non-biocapacity-based resources beyond their local limits may also have an impact on national economies and be useful to include in this analysis. Minerals and water are prominent examples. Putting these resources into terms of global hectares is challenging since they are not living or fossil carbon. However, since energy is required to concentrate minerals and move water, and if this energy comes from fossil fuels, this provides one pathway for translating water and mineral consumption into consumption of biocapacity. Including minerals may require determining how much of their value comes from embodied energy. Water costs might already be included in the commodity costs of biocapacity-based commodities, or there may be additional costs if water is limited in a nation.

Additionally, there are “soft” costs to some biocapacity deficits, in addition to the “hard” costs of their direct values. With Carbon, for example, these could include the costs of compliance with carbon taxes or cap and trade systems, and/or the costs of mitigating the impacts of climate change from fossil fuel burning. Translating these into prices per global hectare could help to reveal a fuller set of costs faced by an economy.

Further, while these costs, and any refinements to them, suggest that biocapacity deficits will impact national economies, they do not show direct causation of higher biocapacity deficit costs with worse economic performance. A series of statistical examinations is likely necessary to help isolate the financial impact of costs of biocapacity deficits.

Finally, other indicators may be needed to complement the cost of biocapacity deficit as an economic assessment tool. For example, examining how the per capita GNI in a country has changed with respect to the per capita GNI of all other citizens in the world would provide some indication of how the purchasing ability of these nations’ citizens has changed over time. This would give an indication of the ability to absorb an increasing cost of biocapacity deficit. Complemented further with data on average external debt service per person would further illuminate how much money is available to nations to finance a high cost of biocapacity deficit, or potentially signal trouble for the economy if cost and debt service are high and purchasing ability is simultaneously declining.

We are beginning to explore these options and questions.

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Appendix 1 – Countries, Former Countries, and Territories Included in Cost of Biocapacity Deficit Calculation[i]

Afghanistan

Albania

Algeria

American Samoa

Andorra

Angola

Antigua and Barbuda

Argentina

Armenia

Australia

Austria

Azerbaijan

Bahamas

Bahrain

Bangladesh

Barbados

Belarus

Belgium

Belize

Benin

Bermuda

Bhutan

Bolivia

Bosnia and Herzegovina

Botswana

Brazil

British Indian Ocean Territory

British Virgin Islands

Brunei Darussalam

Bulgaria

Burkina Faso

Burundi

Cote d'Ivoire

Cambodia

Cameroon

Canada

Cape Verde

Cayman Islands

Central African Republic

Chad

Channel Islands

Chile

China

Christmas Island

Cocos (Keeling) Islands

Colombia

Comoros

Congo

Congo, Democratic Republic of

Cook Islands

Costa Rica

Cote d'Ivoire

Croatia

Cuba

Cyprus

Czech Republic

Czechoslovakia

Denmark

Djibouti

Dominica

Dominican Republic

Ecuador

Egypt

El Salvador

Equatorial Guinea

Eritrea

Estonia

Ethiopia PDR

Falkland Islands

Faroe Islands

Fiji

Finland

France

French Guiana

French Polynesia

Gabon

Gambia

Georgia

Germany

Ghana

Gibraltar

Greece

Greenland

Grenada

Guadeloupe

Guam

Guatemala

Guinea

Guinea-Bissau

Guyana

Haiti

Holy See

Honduras

Hungary

Iceland

India

Indonesia

Iran, Islamic Republic of

Iraq

Ireland

Isle of Man

Israel

Italy

Jamaica

Japan

Jordan

Kazakhstan

Kenya

Kiribati

Korea, Democratic People's Republic of

Korea, Republic of

Kuwait

Kyrgyzstan

Lao People's Democratic Republic

Latvia

Lebanon

Liberia

Libyan Arab Jamahiriya

Liechtenstein

Lithuania

Luxembourg

Madagascar

Malaysia

Maldives

Mali

Malta

Martinique

Mauritania

Mauritius

Mayotte

Mediterranean Region

Mexico

Monaco

Mongolia

Montserrat

Morocco

Mozambique

Myanmar

Namibia

Nauru

Nepal

Netherlands

Netherlands Antilles

New Caledonia

New Zealand

Nicaragua

Niger

Nigeria

Niue

Norfolk Island

Norway

Oman

Pacific Islands Trust

Pakistan

Panama

Papua New Guinea

Paraguay

Peru

Philippines

Pitcairn

Poland

Portugal

Puerto Rico

Qatar

Reunion

Romania

Russian Federation

Rwanda

Saint Helena

Saint Lucia

Saint Pierre and Miquelon

Saint Vincent and Grenadines

Samoa

San Marino

Sao Tome and Principe

Saudi Arabia

Senegal

Serbia

Seychelles

Sierra Leone

Singapore

Slovenia

Solomon Islands

Somalia

South Africa

Spain

Sri Lanka

Sudan

Suriname

Sweden

Switzerland

Syrian Arab Republic

Tajikistan

Thailand

Timor-Leste

Togo

Tokelau

Tonga

Trinidad and Tobago

Tunisia

Turkey

Turkmenistan

Turks and Caicos Islands

Tuvalu

Uganda

Ukraine

United Arab Emirates

United Kingdom

United States of America

Uruguay

US Virgin Islands

USSR

Uzbekistan

Vanuatu

Venezuela, Bolivarian Republic of

Viet Nam

Wake Island

Wallis and Futuna Islands

Western Sahara

World

Yemen

Yugoslav SFR

Zambia

Zimbabwe

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[i] These are sometimes abbreviated names from external data sources, and are not intended to imply official Global Footprint Network views on the legal status or name of any country or territory.