Endless Growth on a Finite Planet: An Ecological Economic Approach to Sustainability

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Abstract

This article is about the conflict between economic growth and ecological sustainability. It suggests a solution from the transdisciplinary field of ecological economics, called the steady-state economy. Unlike standard economics, which is value-based, the steady-state economy is a biophysical model. It thus bears directly on environmental functions as the concept of sustainability in the Geography syllabus requires, and is thus amenable to a variety of geographical inquiry. A case study and many links to the senior Geography syllabus are included which should help facilitate innovation in the classroom.

Introduction

One of the three cross-curriculum priorities in the Australian Curriculum is sustainability. The concept is interdisciplinary and urgent and in this sense well placed within the Curriculum. But the problem arises of how to properly teach for it in a school system that tends to adhere to traditional disciplinary boundaries, especially from high school and beyond. We run the risk of presenting an oversimplified and incomplete account of the issue, or skipping it altogether. Certainly this presents an opportunity for innovation in the way we understand, teach for, and act in response to this issue.

The term sustainability is defined in the 7–10 Geography (ACARA, 2016b) syllabus as '[a]n ongoing capacity of an environment to maintain all life, whereby the needs of the present are met without compromising the ability of future generations to meet their needs.' Despite many of the physical and social sciences addressing sustainability as a cross-curriculum priority, Geography is probably the subject best suited for capturing the broad scope which sustainability requires. It is unique in that sustainability is one of the discipline's integral concepts. The definition it uses for this concept is slightly different to that just given: 'the capacity of the environment to continue to support our lives and the lives of other living creatures into the future' (ACARA, 2016b). There is no mention of human needs, but emphasis is again placed on environmental capacity. The syllabus elaborates on this by stating

> An understanding of the causes of unsustainability requires a study of the environmental processes producing the degradation of an environmental function; the human actions that have initiated these processes; and the attitudinal, demographic, social, economic and political causes of these human actions.

This reinforces the idea that sustainability is based on environmental capacity, as well as functionality. Since the environment is not a static thing, it is the capacity of what the environment does, rather than what it is, that is the object of sustainability. In this sense environmental and ecological sustainability can be treated as synonyms[1]. More will be said about this below in the case study. The passage above also supports the idea that sustainability is a multidimensional concept needing an interdisciplinary approach.

But are some causes of the human actions which degrade environmental functionality more primary than others? The *Australia: State of the Environment* (SoE) reports provide a detailed, longitudinal account of the condition of the Australian environment. The first of these reports, published in 1996, cautiously refers to Australia's growing population and highly concentrated distribution as possible candidates for causing unsustainable environmental changes (State of the Environment Advisory Council, 1996, pp. 10-11). Five years on, the following report contains the repeated concern that population growth and also economic activity are putting pressure on the environment (Australian State of the Environment Committee, 2001, p. 1), as well as the comment that 'Australians face major problems of living sustainably in … a society in which agriculture and industry, population and the built environment all continue to grow' (p. 22). The next report, published in 2006, gives considerable attention to the interrelated issues of population growth and increases in energy, material, and water use and the resulting increase in environmental pressure (Beeton et al., 2006, p. 7-14). The more recent reports state the causes of environmental change more boldly. The 2011 report states that '[t]he principal drivers of Australia's environment…are climate variability and change, population growth and economic growth' (State of the Environment 2011 Committee, 2011, p. 42), and mentions the challenge of 'decoupl[ing] national growth from increased pressure on the environment.' Most recently, the 2016 report

[1] Ecology is the study of the interactions between and among species and their abiotic environments. See Odum and Barrett (2005).

repeats the previous warning by saying '[t]wo drivers will continue to shape Australia's environmental challenges in the coming decades: population growth, distribution and composition; and economic activity' and goes on to say that '[g]rowth and change in our population and industries directly affect the Australian environment through the resources we use and the waste we produce' (Jackson et al., 2017, p. 9).

Given the conclusions of the SoE reports, this article focuses on economic growth as a fundamental driver of the human actions that have not only initiated the degradation of many environmental functions, but continue to do so, since growth is enshrined worldwide in national government policy (see next section). As will be described below, economic growth is closely coupled with population growth – the other repeated concern of the SoE reports.

Maude (2014b) agrees that sustainability must be considered an environmental concept at base, and has made an attempt influenced by economics to make this case (2014a), though without addressing the issue of growth. While some economic geography is concerned primarily with the spatial dimension of production and consumption (for example Daniels, 2008), others emphasise the concept of scale (Pickerill, 2008; see also Diamond, 2006 for an excellent example of both) and in so doing, look critically at the antagonism between growth and sustainability. Yet when it comes to geography education in Australia, there is no explicit treatment of this antagonism. The only mention in the senior Geography syllabus is of the challenge of 'managing economic growth', but nothing questioning the merits of growth itself. The issue also appears to have escaped the Australian Research Institute for Environment and Sustainability entirely (aries.mq.edu.au). van Tol (2017) has made a direct attempt to consider teaching for sustainability through the lens of economic geography, where the focus was on the profit motive of corporate activity. This article will generalise that analysis by considering how the principle of economic growth, which, broadly speaking, contributes to profit margins, tends to conflict with ecological sustainability.

The next section surveys some basic economic theory and shows how its implementation impacts the environment and opposes the goal of sustainability. Following that an alternative development model from ecological economics is presented, and in the final section applications are made to the senior Geography syllabus with some innovative suggestions for teaching for sustainability.

Economic Growth: Theory and Practice

Just about every country in the world today has growth as a core principle of its macroeconomic policy. The Australian Treasury states that 'the challenge for Australia is to raise standards of living through economic growth' and that '[w]e must maintain the growing momentum in the economy' (Australian Government Treasury, 2016). Other countries have similar policies. The EU seeks to set itself 'firmly on the path to growth' (Council of the European Union, 2015) and Goal 1 of the US Treasury is 'Boost U.S. Economic Growth' (Department of the Treasury, 2018). Meanwhile Canada has prioritised 'sustainable economic growth' (Department of Finance Canada, 2018) and the UK's first priority is 'achieving strong and sustainable growth' (HM Treasury, n.d.). The policy extends to the international arena, with Goal 8 of the United Nations' (UN's) Sustainable Development Goals being 'decent work and economic growth' (UN, n.d.). Clearly, governments are in the business of growing the economy.

Economic growth is measured by increases in the Gross Domestic Product (GDP), the sum of the final market value of all goods and services produced within a country in one year (Samuelson and Nordhaus, 2010, pp. 370-1). It is this metric that governments are so anxious to increase year after year. As Figure 1 shows, the Australian government has been quite successful in increasing GDP, without interruption, for over the last quarter century.

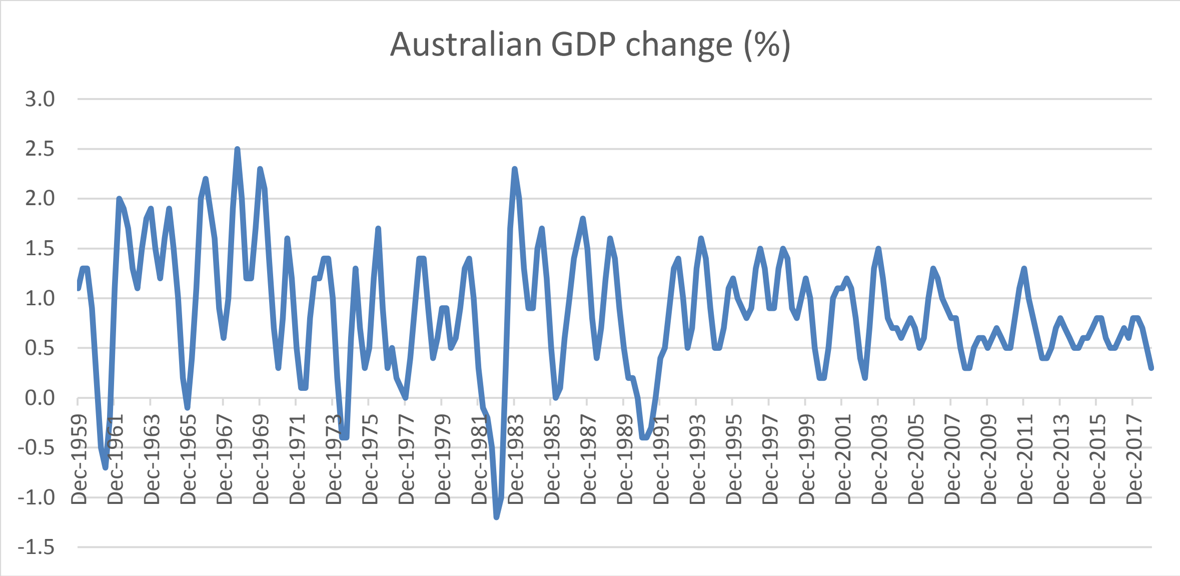

Figure 1. Annual GDP change (%) in Australia, 1959-2018. Source: Australian Bureau of Statistics (2019).

The standard model of economic growth comes from the work of Robert Solow. Although many refinements have been made to it, they all share the same premises that growth depends on three factors: capital, labour, and technological progress (see Samuelson and Nordhaus, 2010, pp. 501–518 for more detail). Despite land having been considered a factor of economic production, and thus growth, by all the classical economists, it, and the natural resources derived from it, are notably absent from Solow's model. The history of why land, and thus resources, was removed as a factor of production from economic theory is interesting and full of political intrigue, but beyond the scope of this paper (see Czech, 2013, pp. 80–101). For our purposes, a few points should be made: for one, the Solow model leads to the peculiar conclusion that because growth proceeds without physical resources, it has no limits. Also, because labour is a factor of production, having a growing population is, all else equal, good for GDP growth (though obviously not necessarily for growth per capita). And finally, it is only the *working* population that contribute to GDP. So for example, while stayat-home moms are not good for growth, wage-earning day carers are; in fact doubly so, since both the day carer and the mom can then do paid work.

One of the confusions that arise from the measure of GDP that help misinform the argument that growth can and should continue without limit is that because GDP is a measure of value (in dollars, euros, yen etc.) it is not limited by physical constraints (Daly, 2014, p. 63). However, GDP is not simply a measure of dollars, but of dollars' worth of stuff. This is made abundantly clear by the Australian Bureau of Statistics (ABS) calculations themselves (ABS, 1998), which show that GDP is in fact a measure of the *volume* of goods and services, rather than value. With this confusion corrected, we are now in a position to make a biophysical analysis of economic growth. What changes in matter and energy use occur as economic growth proceeds? Figure 2 shows the change over time between GDP and the material footprint (MF) of a variety of countries, both developed and developing.

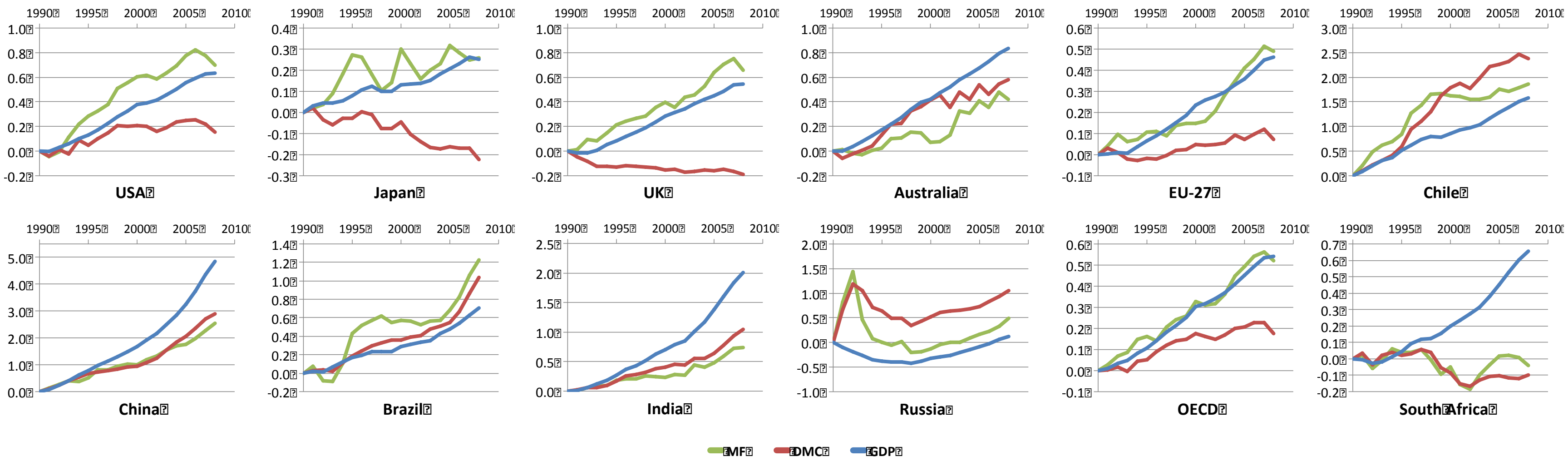

Figure 2. Relative changes in material footprint (MF), domestic material consumption (DMC), and GDP for selected countries, 1990-2010. Source: Wiedmann et al. (2015, 6274).

The MF accounts for all the raw materials embodied in a product, and allocates them to the country where that product is consumed. Other resource flow accounting metrics also exist, like the domestic material consumption (DMC), which is also shown in Figure 2. However, the DMC does not capture all of the ‘upstream’ raw materials related to imports and exports originating from outside the country in question (Wiedmann et al., 2015, p. 6271), leading to the comforting but erroneous conclusion that some developed countries have ‘decoupled’ economic growth from resource use. The trend for the MF however is clear: with the exception of South Africa, every country has roughly a direct proportion between MF and GDP. That is, as their economies grow, so does the amount of material that they consume, which is what we would expect given that GDP is a measure of the volume of goods and services produced. The notable exception of South Africa is one that demands an explanation, but this has not yet been attempted in the literature (Wiedmann, 2019, personal communication). This could make for an interesting geohistorical analysis since the time frame in question begins roughly with the end of apartheid, after which tremendous changes occurred in all aspects of South African society, including its economy.

What happens to energy use while an economy grows? It too is of interest since it is a finite, physical resource. Figure 3 shows the change in Australia's energy consumption versus its GDP for the period 1960 to 2016.

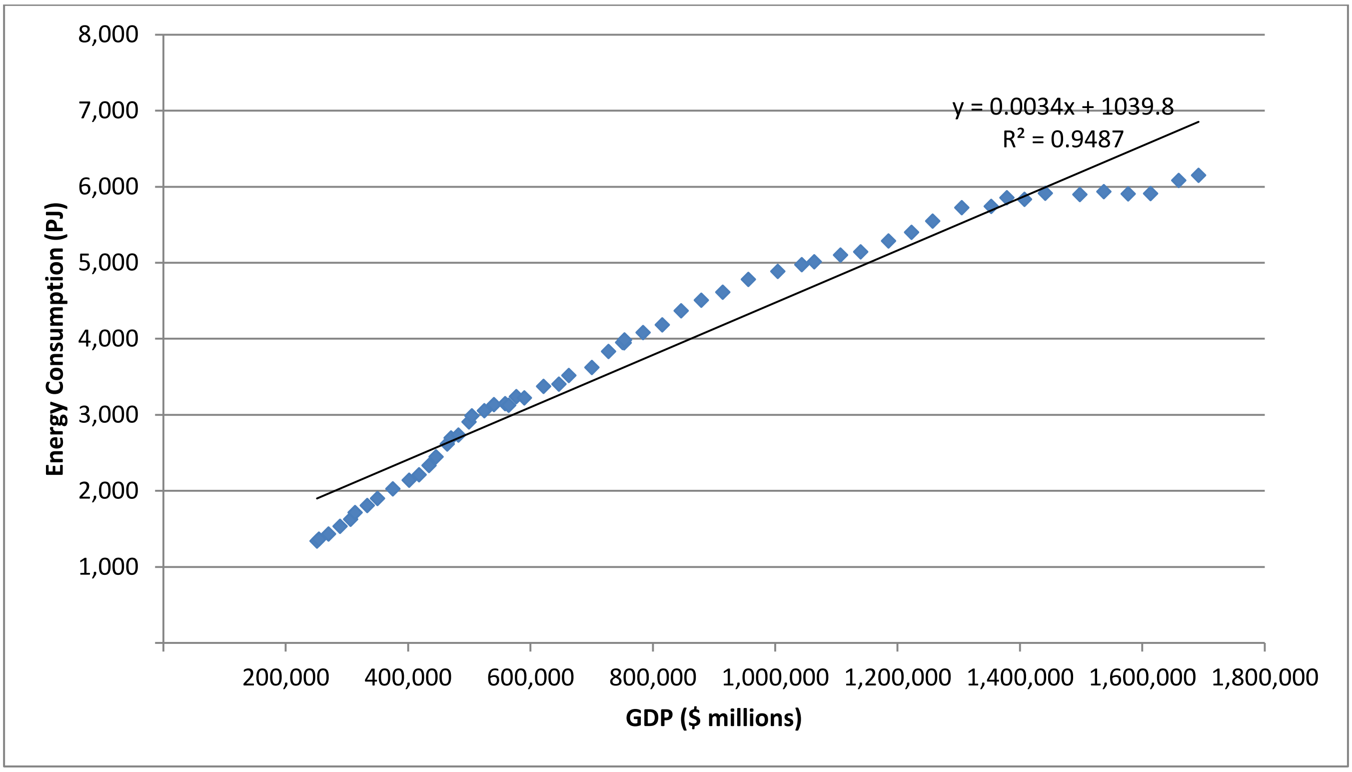

Figure 3. Energy consumption versus GDP, Australia, 1960-2017. Source: Department of the Environment and Energy (2018).

Note that Australia's GDP has been growing faster than its energy use, suggesting that as the economy grows, improvements in technology and economies of scale can use energy more efficiently. Similar results have been found for global analyses of the same sort. Figure 4 shows a plot of the per capita energy consumption versus per capita GDP growth for 220 countries over 24 years. Each thin line represents the data for a single country while the thick black line that for the mean.

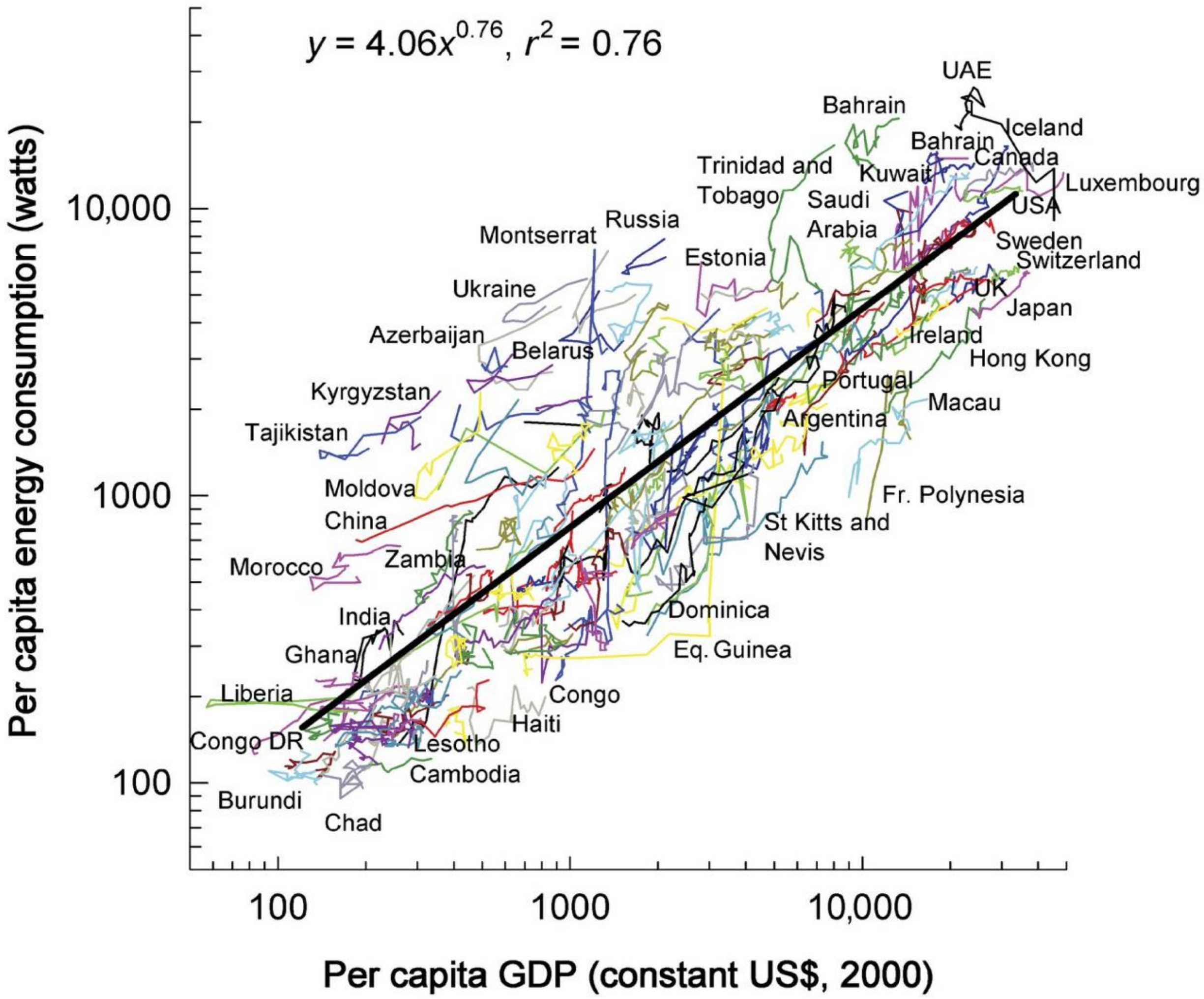

Figure 4. Per capita GDP and energy consumption for selected countries, 1980-2003. Source: Brown et al. (2011, 20).

As these figures indicate, economic growth undoubtedly demands more energy use, which is, again, like the MF, what we would expect given that GDP is a physical measure of the production of goods and services. With this biophysical analysis in view, clearly economic growth cannot continue forever on a finite planet; our affinity for growth has led from what Daly (2014) calls an empty world to a full world – where the world is now full of people and our stuff. Figure 5 helps depict these circumstances.

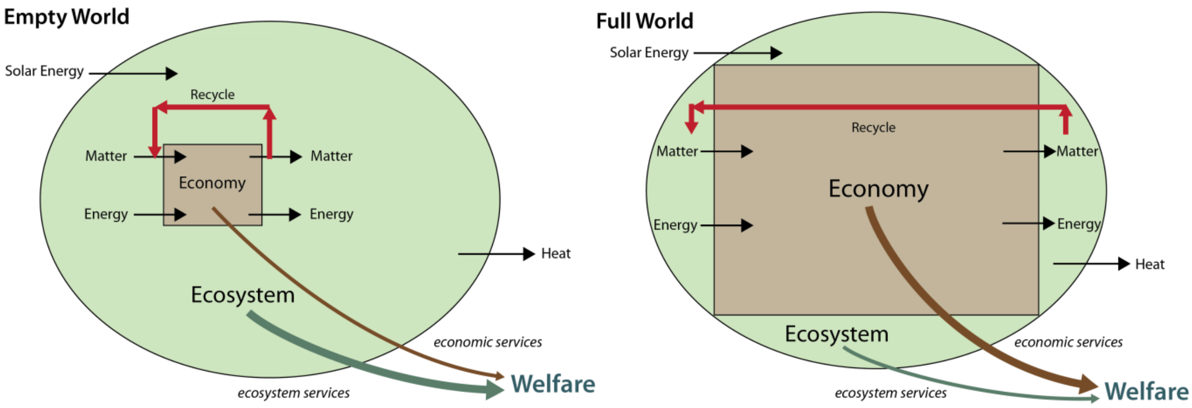

Figure 5. Economic growth causing the transition from an empty world to a full world, diminishing ecosystem services along the way. Source: Daly (2015).

Notice that as the economy grows, while the services provided from the economy also grow, those from ecosystems diminish; this conflict is elaborated on below. Since the economy cannot grow forever, we should be asking: How big should the economy be? The next section addresses this question.

Ecological Economics and the Steady-State Economy

Ecological economics is not really a discipline in the formal sense that it adheres to departmental boundaries and standard methods of inquiry; it is usually referred to as a transdisciplinary field in that it draws on principles and concepts from a variety of fields including physics, biology, ecology, history, anthropology, and economics and synthesises them in its work (Costanza, 2010). Some of its seminal contributors are Nicholas Georgescu-Roegen, Herman Daly, and Kenneth Boulding. Both the journal Ecological Economics and the International Society for Ecological Economics were established in 1989 by Robert

Costanza, who now works at ANU. With Geography's broad integral concepts of interconnections, sustainability, environment, scale, and change, it has much to contribute to ecological economic inquiry and vice versa.

What unites ecological economics are three hierarchical goals, the first of which is called 'sustainable scale'. The second and third goals are fair distribution and efficient allocation respectively, but they are beyond the scope of this paper. Sustainable scale attempts to answer the question: How big should the economy be relative to the containing biosphere? As mentioned above, this question is completely absent in standard economics, which advises unlimited growth instead. Before answering the question just posed, we might first ask: How big is the economy? In dollar terms the gross world product is about US$80.7 trillion (World Bank, 2019), but ecological economists are interested in providing a biophysical answer to this question. One way to do this is by considering what percentage humans appropriate of the earth's potential net primary production[2] (HANPP). This is currently 25% and it may only grow to about 27-29% by 2050, but large increases in bioenergy might see it increase to about 44% (Krausmann et al., 2013).

How big should the economy be is a question that has no definite answer, but a few things can be said with some certainty. For one, two more doublings of HANPP would leave no bioenergy available for any species other than humans and our domesticated animals. Because crucial ecosystem services depend on these other species, HANPP should not grow to such levels (Daly, 2014). Also, globally over the last century HANPP per dollar has declined by more than a factor of eight (Krausmann et al., 2013), suggesting that further economic growth in dollar terms might be possible, even while HANPP remains relatively stable. However, this has occurred because of the enormous increase in the use of fossil

[2] Net Primary Production (NPP) is the energy captured by plants via photosynthesis minus that which they use during respiration. This energy is the basis for virtually all food chains in the biosphere.

rather than bioenergy (Smil, 2017). Not only are such non-renewables limited at the waste end by contributing to climate change, but they are increasingly limited at the source end too (Hall, Lambert, and Balogh, 2014). Because energy is an essential resource for economic production – indeed for doing anything at all – this suggests that further economic growth will soon begin to reach earth's biophysical limits. Some research suggests that this is already happening, not only in terms of climate regulation, but also in biodiversity loss and overextension of the nitrogen and phosphorus cycles (Rockström et al., 2009; Steffen et al., 2015). Thus, the precautionary principle suggests that the economy should probably not encroach upon the biosphere anymore, and that we need to change our pro-growth policies.

For about 50 years now Herman Daly has been promoting the steady-state economy (SSE) (Daly, 1993, pp. 325–363). While there are many nuanced arguments supporting the SSE, it has four defining characteristics:

1. A constant or mildly fluctuating human population.
2. A constant or mildly fluctuating stock of human artifacts.
3. The levels at which 1 and 2 are held steady are sufficient for a good life and sustainable into the future.
4. The rate of matter and energy (collectively referred to as 'throughput') which sustain 1 and 2 are kept as low as possible.

Readily apparent is that the SSE is in direct opposition to the biophysical results of a growth economy, where, as we have seen, both matter and energy increase as the economy expands. Also notable is that a zero-growth economy need not have any negative connotations; this is because development can still occur, independently of growth. Growth is specifically a quantitative, biophysical phenomenon. It occurs as throughput increases. Development on the other hand entails qualitative changes that occur with throughput held constant. These include changes in information, technology, fashion, and income and wealth distribution. A good analogy to our economy is a human body: a baby grows but eventually stops accreting matter and demanding more energy, but a grown adult can continue to develop by education and experience throughout her life without any growth at all.

Applications for Senior Geography

There are opportunities to apply the model of the steady-state economy, and ecological economics more generally, to all four units of the senior geography syllabus. What follows is an overview of some suggestions for each one, outlining how the concept of a steady state versus that of growth might be used as a unifying theme for teaching senior Geography. Also included is an in-depth case study as part of Unit 2.

Unit 1: Natural and Ecological Hazards

We have seen that economic growth is coupled with increased energy usage. Despite the push toward renewable sources of energy, the global economy still relies predominantly on fossil fuels (about 81%) (International Energy Agency, 2018). If nuclear is added to this, the non-renewable energy total comes to about 86%, leaving renewable sources of energy providing only about 14% of the total global economic primary energy supply. When we consider that many natural hazards (e.g. floods, droughts, cyclones) are caused by global warming (Intergovernmental Panel on Climate Change, 2018), and that anthropogenic global warming is being driven to a large extent by carbon emissions from fossil fuel use, then the policy of increasing economic growth must be seriously questioned and it would seem prudent to transition to a SSE.

Weighing against the hope that renewables will quickly replace fossil fuels in a growing economy is the fact that biofuels comprise the majority of renewable sources of energy (about

70%, or about 10% of total global energy supply); as suggested above, expanding our use of biofuels will increase the HANPP and thereby reduce the habitat for species other than humans and our domesticated animals. Also, such increases must compete with agricultural land, putting increased food pressures on a growing global population. These considerations can help address the following content descriptors:

- the nature and causes of the selected hazard and explain how the activities of people can intensify its impacts (ACHGE016)

- the concept of risk as applied to natural and ecological hazards (ACHGE013)

Unit 2: Sustainable Places

Given the Geography syllabus' definition of sustainability, this unit should be called 'sustainable environments' rather than sustainable places, especially since the syllabus calls places 'cultural constructs' (ACARA, 2016a) rather than biophysical phenomena. More about this will be said below in discussing ecosystem services. That notwithstanding, this unit explores the sustainability of places given the challenges of, among other things, population growth and 'managing economic growth'. As discussed above, the SoE reports conclude that these are in fact *the* prime challenges to the sustainability of places in Australia. As such, the most appropriate response to them would seem to be not so much 'managing' economic growth, but abandoning it and transitioning to a steady-state, or even for some time, a shrinking economy and population. As noted above, this still allows for economic, educational, and cultural development. Growth versus steady-state economics can inform all of the knowledge and understanding-based content descriptors of the depth study focussing on a place in Australia, in particular:

- the nature, scope and causes of the selected challenges being confronted and the implication for the place (ACHGE046)

The final three such descriptors (ACHGE047, -048, and -049) are all about strategies for addressing the selected challenge – in this case, the conflict between economic growth and ecological sustainability. Yet as Samuelson and Nordhaus (2010, p. 506) have stated, '[v]irtually everyone is in favour of economic growth'; as such, few appropriate strategies have even been suggested, much less implemented, to address this challenge. However, the 'circular economy' is one proposal that has recently received much attention by both government and industry (see for example Ellen MacArthur Foundation, 2017). The New South Wales government has issued a policy document stating that it is committed to transitioning to a circular economy (State of NSW and NSW Environment Protection Authority, 2019). While a detailed analysis of the circular economy is beyond the scope of this paper, a few points should be made. First, the circular economy does not make any fundamental departure from the growth economy. In fact, one of the stated benefits of a circular economy is that it promotes more growth (State of NSW and NSW Environment Protection Authority, 2019, p. 2, 3). Given what has been argued above, this alone should cast serious doubt on the efficacy of this strategy to contribute to a sustainable society. Next, there are technical reasons based on the laws of thermodynamics – among the most fundamental principles of modern science – which prohibit anything like a perpetual motion 'circular' economy (see for example Daly, 2014; Georgescu-Roegen, 1971; Giampietro, 2019; Giampietro, Kovacic, Strand, and Volker, 2018; Korhonen, Honkasalo, Seppala, 2018). While increased recycling should be welcomed to reduce raw material extraction, those laws ensure that nothing can be recycled without energy input. In a circular economy then, we are simply trading off some material growth for additional demand for energy, which itself is limited. Finally, the circular economy says nothing about population growth. Even if per capita material and energy use remain constant, a growing population will continue to displace ecosystems, degrading the services they provide. On all of these points the steady-state economy provides a better strategy for creating a sustainable environment.

Byron Bay: A Case Study

In the introduction reference was made to the core idea of sustainability resting on environmental functionality. Ecosystem services, which form a key area of research in ecological economics, are very closely related to environmental functionality. Although there is no canonical definition of them, the general idea is that they are things that ecosystems do which benefit people (see for example Department of the Environment, Water, Heritage and the Arts, 2009; Millennium Ecosystem Assessment, 2005). While listing all ecosystem services is impractical, perhaps even impossible (Sekercioglu, 2010), some of the most prominent ones have been evaluated by Costanza et al. (1997) and are reproduced in Table 1 along with some examples.

Number	**Ecosystem Service***	**Examples of benefit to humans**
1	Gas regulation	CO_2/O_2 balance and O_3 (ozone) for UV protection.
2	Climate regulation	Greenhouse gas regulation.
3	Disturbance regulation	Storm protection, flood control, drought recovery controlled by vegetation structure.
4	Water regulation	Provisioning of water for agriculture
5	Water supply	Provisioning of water to catchments, reservoirs, and aquifers.
6	Erosion control and sediment retention	Prevention of soil loss due to wind and rain.
7	Soil formation	Weathering of rock and accumulation of organic matter.
8	Nutrient cycling	Nitrogen fixation and N, P and other mineral cycling.
9	Waste treatment	Detoxification and pollution control.
10	Pollination	Provisioning of pollinators and reproduction of plants.

11	Biological control	Predator control of prey species.
12	Refugia	Habitat for resident and migratory species.
13	Food production	Provision of crops, fruit, nuts, fish, and game.
14	Raw materials	Provision of timber, fuel, and fibre.
15	Genetic resources	Medicine and provisions for genetic research.
16	Recreation	Sport fishing, hunting, and any outdoor recreational activity.
17	Cultural	Aesthetic, artistic, educational, spiritual, and scientific values of ecosystems.

* Ecosystem 'goods' have also been included in this list.

Table 1. General list of ecosystem services. Source: Costanza et al. (1997).

In order to make the conflict of economic growth with ecological sustainability an object of geographical inquiry, teachers and students can choose an ecosystem service and attempt to measure any reduction in it while economic growth occurs in a particular environment. Some ecosystem services, like gas and climate regulation, are not localised and would escape simple measurements conducted by a class in their local environment. For these, studies would depend on secondary data. Others however, like refugia and disturbance regulation, are localised and degradation of them during economic growth can be observed and directly attributed to that growth, making them amenable to primary data and thus fieldwork. Note that like ecosystem services, some economic projects are diffuse, whereas others are localised. Some projects, like the NBN network being rolled out across Australia for example, are not amenable to high school fieldwork, whereas a particular construction project is. An example of such growth and its impact on an ecosystem service comes from the author's home town of Byron Bay.

Despite its small population of about 30,000 people, Byron Shire is one of the most common tourist destinations in all of Australia, receiving over two million visitors each year; these numbers have been growing and are projected to continue growing (Delta Pearl Partners, 2019). Such dramatic increases have resulted in, among many other problems, traffic congestion. One of the ways the local council has decided to cope with this growth has been to construct a bypass around the town centre. The cost of the project is $24 million, with close to half the money coming from a state government Growing Local Economies grant (Byron Shire Council, 2019). Naturally, this will contribute to GDP growth and thereby to the fulfilment of Australia's macroeconomic policy objectives. However, the bypass will go through wetlands which provide the habitat of a number of threatened species, including Mitchell's Rainforest Snail, Common Planigale, and Black Bittern, thereby reducing the ecosystem service of refugia for these and other species, since they will not live on or near the bypass (Lovejoy, 2019).

While the conclusion that this example of growth reducing the ecosystem service of habitat provision is completely obvious, that does not make it trivial, nor irrelevant. In response to the anthropocentric view that we can and must afford the reduction and extinction of other species to make room for more of us and our stuff, there are many examples of trophic cascades – that is, amplification of disturbances in food chains – which demonstrate the myopia of such thinking. The reintroduction of wolves to Yellowstone National Park is one example (Ripple and Beschta, 2012), the possible rise of Lyme disease due to the human-induced extinction of the passenger pigeon is another (Blockstein, 1998; Farley, 2012). In the case of the Byron bypass, the Black Bittern is an apex predator and thus supplies biological control (see Table 1) to the trophic structure of the wetlands through which the bypass is planned. While proving that continual economic growth will cause catastrophic dysfunction of ecosystem services is probably impossible for one specific case, the precautionary principle suggests that limiting growth in the aggregate would be prudent. This is the conclusion of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in their recent Global Assessment Report. Therein they note that about 1 million species are threatened with extinction, many within decades, and suggest ‘steering away from the current limited paradigm of economic growth’ (IPBES, 2019). This line of reasoning extends to the next Unit.

Unit 3: Land Cover Transformations

Land cover transformations are intimately related to economic activity, causing depletion of resources at the extraction end, waste during both production and consumption, and expansion of anthropogenic biomes (IPBES, 2018). What was said above for Unit 1 about climate change applies equally well to the first two descriptors of this unit (ACHGE075 and -076), and for the same reasons.

Similar arguments apply to the interrelationships among land cover transformations, economic growth, and loss of biodiversity and ecosystem services since, as the economy grows, it encroaches on species’ habitats, disrupts ecosystems, and reduces biodiversity (Odum and Barrett, 2005, pp. 318–326). As the IPBES states ‘[l]and degradation and thus loss of biodiversity and ecosystem services is the most pervasive, systemic phenomenon with far-reaching negative consequences for human well-being worldwide,’ yet ‘[l]and degradation is often not recognized as an unintended consequence of economic development’ (2018, p. xxiii), by which they mean economic growth, in the sense used in this paper. These considerations thus bear on the following descriptors:

- The causes, rate and projected impacts of declining biodiversity. (ACHGE079)

- The interrelationships between land cover change and biodiversity loss…. (ACHGE080)

- The effects of biodiversity loss on ecosystem services and species, and ecosystem and genetic diversity. (ACHGE081)

SoE (2016) states that Australian biodiversity is ‘generally considered poor and deteriorating’ (p. 27). As such, the depth study in this unit to address land transformations provides a great opportunity for students to do something about the fundamental conflict between economic growth and ecological sustainability. The case study above suggests how they may begin. Though on the surface the conclusion appears to be a kind of conservation biology, the innovation for teaching being suggested here is to go after the root cause of the problem. While students may fail in trying to persuade local councillors and other decision makers to repudiate economic growth and adopt the steady-state economy as a policy, this could be a good lesson in itself. It may help them gain insight into the way political and economic systems often work, instead of being deluded by gimmicks like the circular economy, which do not, as argued above, address anything fundamental about the conflict.

Unit 4: Global Transformations

The part of global transformations focussing on economic geography clearly lends itself to a discussion of growth versus steady-state economics. When the unit description talks about the economic dimension of international integration, there is a direct link to the expansion of existing markets and the creation of new ones, both international and domestic. Economic growth and the creation of new markets have a long history that tracks colonialism and the building of empires. Though in the political sphere empires and colonies may have ended, in the economic sphere they are thriving. Consider the mining industry. It is an essential primary industry feeding mineral and fossil energy inputs into the growing economic system. 60% of mining companies are headquartered in Canada, yet their activities are global and often have grave social and environmental repercussions. These include forced migration, torture, and slavery, as well as deforestation, water contamination, and cyanide and arsenic poisoning, amongst many others. As the Tricontinental: Institute for Social Research (2019) shows, mining companies’ environmental offences occur in parallel with their human rights violations and concludes that ‘[c]ollectively Canadian mining companies display a depraved indifference to human life. And this indifference is considered to be just a natural or necessary side effect to economic growth’ (p. 3). As the world becomes increasingly full of people and our stuff, avoiding these sorts of abuses becomes more and more difficult.

Broadly speaking, the following content descriptor addresses these issues:

- The process of international integration, especially as it relates to the transformations taking place in the spatial distribution of production and consumption of commodities and services…. (ACHGE099)

In keeping with the focus on the mining industry, by choosing ‘a mineral or fossil-based energy resource’ for the depth study on international economic integration, students will have the opportunity to draw out many details of growth vis-à-vis sustainability. Many content descriptors apply, including:

- the changes occurring in the spatial distribution of its production and consumption, and the geographical factors responsible for these changes (ACHGE103)

But also (ACHGE105–107, -109, and -110)

While students must be free to choose their own depth studies, including the conflict between economic growth and ecological sustainability as part of a senior geography program can help frame many of the geographical issues contained in them and deepen students’ understanding of their rudimentary causes.

Conclusion

The conflict between economic growth and ecological sustainability is a serious and urgent problem. One way we can begin to address it is to educate students, and the public of all ages, so they are aware of the issue and the steady-state solution. With its broad integral concepts, Geography provides the best opportunity for innovative pedagogy that does this. The financial aspect of the economy, which has not been discussed in this paper, also has an important role in driving the biophysical expansion of the real economy, degrading ecosystem services as it does so; it too is in need of reform. Attempting a smooth and non-violent transition to a steady-state or even degrowth economy, before nature forces us to do so, should be considered one of our civilisation's priorities. Geography teachers have an important role to play in this attempt.

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