The Politics of the Global Footprint Network Resistance to Changes to the Ecological Footprint Metric

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring, 2022

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Abstract

The Ecological Footprint (EF) metric has been used by the Global Footprint Network (GFN) to aid multiple communities around the world to guide environmental choices and policy. However, this indicator has received criticisms from various scientists for its over-simplification and lack of accuracy. Specifically, the focus of this analysis will be the recommendations to adjust the metric in terms of taking into account land types to make their land area conversion, adjust their oversimplifications around the carbon footprint and getting the data about carbon footprint from more than one source. These recommendations are aimed at improving the accuracy of the EF metric, which is crucial since the metric is used to guide environmental policy all over the world. The adjustment or lack thereof of this indicator can better be understood through the co-production lens. This term was first coined by Sheila Jasanoff in her works *States of Knowledge* and *Designs on Nature: Science and Democracy in Europe and the United States* that accentuates how the way the world is understood scientifically constantly transforms and informs social constructs such as environmental metrics and policies. Even when the criticism has come from various sources, the GFN has not changed the Ecological Footprint metric according to the new scientific information aimed at improving it. Other actors, however, have taken into their hands to adjust the metric in order to improve it. Since this metric is so widely used and easy to understand its use should not be discontinued, but rather it should be adjusted using the scientific recommendations by the GFN or other actors who are willing to retroactively adjust it.

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Introduction

In the 1970s, as measured by natural-resource accounting techniques, human demands on the planet's ecological resources started to surpass the rate at which nature can regenerate said resources (SPUR, 2011). Since human consumption of natural resources has only continued to increase, the resources we use and the natural systems we rely on to sustain ourselves today outpace the amount of resources that the planet can provide. To measure the burden humans place on Earth resources, scientists have found multiple ways to quantify the sustainability of our actions. One of the most used and influential ways to do this is the Ecological Footprint (EF) metric calculated by the Global Footprint Network (GFN). The GFN, founded in 2003, is a nonprofit that uses United Nations data to calculate said metric (GFN, n.d.c). The EF is a sustainability calculation developed in the 1990s by William Rees and Mathis Wackernagel, the CEO of GFN. It quantifies human demand on natural ecosystems against their capacity to regenerate (Wackernagel & Pearce, 2018). The EF can purportedly determine the theoretical date in a given year when, at current rates of consumption, humans will have depleted resources beyond Earth's capacity to regenerate them (GFN, n.d.a). In 2021, this date was July 29th.

The importance of analyzing how the Ecological Footprint lies on the fact that it is widely used by multiple regions to drive environmental choices and policies (GFN, n.d.d; GFN, n.d.e). This metric has become widely used and famous around the world. One prominent case in which this calculation has been used is Switzerland that started using the metric in 2006 and was the first country to partner up with the GFN to do this (GFN, n.d.e). This is of importance as once the first country used the EF to access their sustainability, other regions also do the same,

such as Portugal (GFN, n.d.d). These are only two examples of the variety of regions that have used the EF to access their sustainability metric and make decisions accordingly. Though the EF has been applied to guide sustainability policies, it is controversial since some researchers contend that it is an inaccurate measure (Office, 2006; Van den Bergh and Grazi, 2014). GFN's strategies, including its use of the EF, are, therefore, worth closer examination. This entails looking at researchers who have evaluated the EF as a measure of humans' demands on natural ecosystems; some have proposed revisions. For example, Jóhannesson et al. (2019) recommend improvements to EF's marine component. Giampietro and Saltelli (2014) fault the EF Carbon Footprint equation for the unclear figures for its variables. While Li et al. (2022) find the EF useful, they utilize scientific insights to propose added complexities to the metric such as mixed land uses and perform the EF calculation taking these insights into account.

The scope of this paper consists of understanding the Ecological Footprint metric, how it was created and how it has or has not been modified based on new scientific information and criticism received. I will look at the research done to create the metric as well as the new discoveries and recommendations that have been made by scientists on the different factors that may change this metric. To do this, I will be using the co-production framework, first described by Sheila Jasanoff to look at how new discoveries in science change metrics (Jasanoff, 2004). Though the Ecological Footprint metric has been used by multiple communities to guide their environmental choices, it has received criticisms from various scientists for their lack of complexity in certain areas. Even when the criticism has come from various sources, the GFN has not changed the EF according to the new scientific information aimed at improving it. Though GFN has not taken the criticism to re-work their metric, other scientists have used the new scientific insights to change said metric as discussed through the co-production lense.

Ecological Footprint Metric

The Ecological Footprint is a sustainability metric developed in the 1990's by Professor William Rees and at the time Ph.D. student Mathis Wackernage at the University of British Columbia (Wackernagel & Pearce, 2018). Though the concept was first mentioned in a paper published in 1992 as 'regional capsule', the term Ecological Footprint was coined soon after by Rees when criticizing economic models of resource use (Collins & Flynn, 2015). The EF is a tool that measures the amount of Earth's regenerative capacity needed to support humans and activities such as food production, housing, transportation and consumption of other goods and services (GFN, n.d.b.). In this way, the EF measures the extent at which human demands exceed the availability of resources is the biosphere. To develop this idea, Rees drew upon the notion of carrying capacity, which is the maximum population that can be sustained by a given environment (*Carrying Capacity - an Overview | ScienceDirect Topics*, n.d.). However, this metric varies due to fluctuations in the climate and not taking into account trade of resources between areas or the ability of technology to overcome resource scarcity in some cases (Collins & Flynn, 2015). In addition, this metric may not be of the most practical use since it is given in Earth's capacity and this can make it difficult to interpret in terms of human resources and human consumption terms.

This problem was addressed in the EF metric by not looking at the maximum amount of population per environment that would be sustained but looking at how much area was needed per individual in a population. This allows for focus on the land limits rather than focus on growth of population when having discussions about the environment (Collins & Flynn, 2015). Therefore, the Ecological Footprint metric "adds up all the productive areas for which a population, a person or product competes" (GFN, n.d.b). Specifically, it measures ecological

assets that a population or product needs to consume and to absorb its waste. The ecological assets include food, livestock, fish products and foster products for urban infrastructure and the carbon emissions caused by absorbing the waste. Additionally, the EF metric tracks productive surface areas such as croplands, grazing land, fishing ground, built-up land, forest area and carbon demand on land. It also takes into account how the unused land may absorb waste generated by carbon emission from different sources such as burning fossil fuels. As mentioned before, this calculation is expressed in land area, specifically in globally standardized hectares for global comparability (GFN, n.d.b). When a population EF exceeds the region's biocapacity there are three things that can happen to meet the need: importing, overusing ecological assets and emitting carbon dioxide into the atmosphere. At the other extreme, there may also be a case in which their biocapacity exceeds the EF and in that case the region has a biocapacity reserve. The EF is now widely used by scientists, businesses, government, individuals and institutions that monitor ecological resource use and use it to make important environmental and sustainable policies.

Method Sources

To analyze the Global Footprint Network's steps to adjust the ecological footprint metric based on scientific information that has been pointed out, the co-production framework will be employed. This framework was first described using this term by Sheila Jasanoff, who is a pioneer in the field of the intersection of science and technology in law, politics, and policy of modern democracies (*Sheila Jasanoff*, n.d.-a). Dr. Jasanoff was instrumental in founding the Science and Technology departments in both Harvard and Cornell University. The science and technology studies field has made progress in the last 20 years to reveal and analyze the relationship between scientific knowledge and political power (Jasanoff, 2004). In the book

States of Knowledge, edited and organized by Dr. Jasanoff, this concept is synthesized and presented in a collection of essays by different experts in the field. Through this means, the concept of co-production was developed, which epitomizes how scientific knowledge (how we understand the world) is waved into different social identities (how we organize the world). Overall, co-production is the process through which we use the way we understand the world to give meaning to ideas and objects through different aspects such as policy making (*Sheila Jasanoff*, n.d.-b).

Co-production is further explored by Sheila Jasanoff in her book *Designs on Nature: Science and Democracy in Europe and the United States* (Jasanoff, 2005). This book looks at 25 years of scientific development embedded with social development in Britain, Germany, the United States and the European Union. She makes special emphasis on how biotechnology was evaluated by public and private actors to ensure their safety, further elucidating the union between the social sciences and technology. In addition, the book also touches on three other themes related to co-production: democratic theory cannot be understood without politics of science and technology, policies of life sciences are used to re-image what these nations stand for and lastly, political culture works through the ways citizens understand public knowledge and this culture influences democratic politics. These takes specifically connect with the topic of Ecological Footprint calculation as the scientific insight presented below can help drive the change of this metric that ultimately affects society and policy.

Lastly, the co-production framework can also be understood through the lens of the book *Origins, Diffusion and Development of the Ecological Footprint: The Ecological New Development in Policy and Practice* (Collins & Flynn, 2015). This book was of special interest as it also uses the co-production framework to analyze the Ecological Footprint. However, the

approach taken by the authors focuses on demonstrating how policy is changed by science, in this case the science being the EF metric. In this work, the authors analyze how the EF has been used in practice to change policies in different communities, demonstrating the point that Dr. Jasanoff has elucidated in her works of how scientific, in this case, environmental knowledge is used within organizations, and how it is able to carry authority in policy making processes. Through the same approach but with a different angle, I will look at how other scientific attributions and recommendations have or have not adjusted the Ecological Footprint that ultimately is used to change policy.

Scientific Insights about the Ecological Footprint and Co-Production Analysis

Though the Ecological Footprint was created in 1992 and was used as a possible solution to address the unreliability of the carrying capacity metric, it is important to investigate what new scientific knowledge and insights have been used to gauge its accuracy and reliability. For instance, in 1998 van den Bergh and Verbruggen analyzed and criticized the Ecological Footprint metric by pointing out that this metric requires that different consumption categories be translated into land area (J. van den Bergh & Verbruggen, 1998). Specifically, they pointed out that this conversion is incomplete as it does not take into account the land types. Due to this, the consumption to land conversion does not represent the relative scarcity changes over time or variations over space. This can cause different categories to receive the same weight even when their environmental impact is not the same. One clear example brough by these authors is that EF does not distinguish between land use for infrastructure and land use by agriculture, although both of those categories have different environmental impacts as the land use for infrastructure is more environmentally destructive than land use for pasture. Another scientific insight given by the same authors about the EF has to do with the fact that their indicator is reported in terms of

hypothetical land area, or global hectares (J. van den Bergh & Verbruggen, 1998). The authors warn against this as this could be a case of "false concreteness." This poses a danger of misinterpretation by the general public and politicians as this indicator can hypothetically exceed the planet's available productive land. In addition, the EF does not define sustainable or unsustainable land to measure the degree that certain activities may contribute to unsustainability like soil degradation which takes away from its accuracy.

Van den Bergh and Verbruggen make emphasis on the fact that the Global Footprint Network does not warn users about the limitations of the Ecological Footprint (J. van den Bergh & Verbruggen, 1998). Since the Ecological Footprint is meant to serve as criteria to make environmental policies, it is problematic and misleading that constraints like this are not clearly stated by the creators of the EF. The solution proposed by the authors is to implement not only one metric like the EF but to have a decomposition type of approach with complete systems of multiple indicators that allow for trade-offs among different ecological dimensions. This means distinguishing between population density, consumption and production of goods and services per individual and unsustainable land use associated with each type of good or service. The authors also recommend being careful with the false concreteness of how their indicator is described. Lastly, a clear definition of sustainable and unsustainable land activities is also suggested to improve the EF.

Despite criticism of the EF metric, it continues to gain popularity as demonstrated by the increase of its use and application in scientific journals (J. C. J. M. van den Bergh & Grazi, 2014). This 2013 article "Ecological Footprint Policy? Land Use as an Environmental Indicators" from van den Bergh and Grazi conclude that despite this, the indicator should not be used to make policy due to its lack of complexities and accuracy. In addition, Giampietro and

Saltelli also make their own scientific analysis of the metric and give suggestions (Giampietro & Saltelli, 2014). These authors focus on the fact that EF uses the estimate of carbon footprint due to energy production to make their calculations of the indicator. However, the paper claims that due to the assumptions and simplifications that the EF uses to estimate the carbon footprint of regions, it cannot be defended or utilized in a meaningful way to make environmental decisions. They go as far as saying that this metric is a media-friendly narrative to reassure people that their impact on Earth is not as grave as it really is.

In 2014, Wackernagel, one of the original creators of the EF responded to some of the criticisms made to the metric (Wackernagel, 2013). He was more specifically responding to the criticism made by van den Bergh and Grazi. In his response, he stated that the criticisms brought to the EF were not sustained and that the following questions needed to be answered before they could begin to criticize the metric. First, "[w]hat underlying question does the Footprint address?" Secondly, "[i]f the question the Footprint addresses is clear, is the question relevant to policy concerns?" Lastly, "[i]f the Footprint question is relevant, are there more accurate methods available elsewhere for answering its particular question?" According to the co-author of the Ecological Footprint, until van den Bergh and Grazi are able to answer those questions, they could not state whether the EF is a good metric to drive environmental policy. Based on the lack of change or real response to the criticisms of the metric, one questions whether Wackernagel's intentions are to actually create a measure of sustainability that is accurate. In addition, Wackernagel also states that the Grazi and van den Berg's paper "repeats previous criticism about Footprint accounts without substantiation" (Wackernagel, 2013). The author reiterates that the EF accounts are not anti-trade nor anti-technology and that if the results of this metric are thought to be excessively inaccurate, the results should be tested by the end-users.

Wackernagel quotes proof that their footprint metric has been tested by end users and it has been within 1-3 percent error of the GFN calculation.

Ultimately, this response from one of the creators of the EF displays his confidence in the metric and his lack of adjustment of the metric due to new scientific insight. He ultimately leaves it up to the scientific advisors of a region to determine if the metric does accurately depict that region's situation. In his response, we can see how even through multiple new scientific insights aimed at improving the metric, the co-creator of said metric does not attempt to retroactively change the EF as new information comes in. The reasons for this resistance to change the metric to make it more accurate is not clear. However, since the metric has been so widely used it is possible that the creator does not want to acknowledge that the metric may be incomplete or inaccurate so there continues to be a demand for its use.

In “Data Accuracy in Ecological Footprint’s carbon footprint” published in 2020, more scientific knowledge was illuminated about the EF (Jóhannesson et al., 2020). In this case, the authors focused on the carbon update component (CF) which makes up about 50% of the EF calculation. The authors claim that the CF is misleading due to the use of estimates and averages for the calculations as well as discrepancy between data collected locally and data from international databases. They point out that the most worrisome part is their lack of warning of limitations, which may be attributed to the fact that the GFN is a think tank that promotes the use of EF and uses greenhouse gasses estimates from a single data source which can create inaccuracies.

Though the creators of the metric have not addressed the scientific advice, others have included some of it to fix the metric. In 2022, Li et al published an article where they take into consideration some of the scientific knowledge that had been pointed out to improve the EF to

calculate a metric (Li et al., 2022). Specifically, the authors of this article acknowledge the metrics lack of "value accounting, incomplete account content, neglect of multi-functions of land, and geographical spatial heterogeneity." They use the knowledge of these limitations to improve the calculation of the metric for 31 provinces in China. To improve the value accounting of the ecological footprint model, this study takes national hectares (nha) as the measurement unit and includes the freshwater and pollution footprints. In this specific instance, the authors of this work adjust the metric for the multi-function of land and spatial heterogeneity. This was done with the goal of being able to accurately measure the natural capital in these regions of China. This shows how scientific insights can be used to change the EF metric, but the changes made to it are social and technical choices aimed at obtaining a specific goal. In the same way, with the goal of obtaining a more accurate metric that aids society make better environmental policies can also be achieved. This elucidates the fact that science and society are interdependent and to be able to maintain just and accurate environmental policies, scientific insights should be taken into account.

Advantages of the Ecological Footprint Metric

Others may argue that the limitations of the EF may be considered strengths in some aspects. As discussed in this paper, the main limitations of the EF are its inaccuracy due to extreme simplification. This does mean that there is a lot of sensitivity in some of the calculations which may lead to inaccurate results. It is also criticized for being only one metric, that is argued not to be enough to understand the pressure humans put on the environment. However, it does mean that it is a singular number which may be argued to be easy to understand and easier to drive policy as it lacks complications. Though this may be an easier number to digest by politicians and the general public because of its simplicity, it is impossible to ignore the

lack of warning from the GFN about its limitations and its possible inaccuracy. Ultimately, even if it is easier to understand, a sustainability metric should also be extremely accurate to be able to drive the needed policy and guidelines around sustainability.

Conclusion

Even though the reason is not completely clear, the Global Footprint Network and its co-creator have not taken different scientific expertise into account to retroactively adjust the Ecological Footprint metric. These adjustments could have included taking into account land types to make their land area conversion since these would yield different numbers (J. van den Bergh & Verbruggen, 1998). Furthermore, they could adjust their simplifications around the carbon footprint to take into consideration more than just carbon from energy production (Giampietro & Saltelli, 2014). Additionally, getting the data about areas' carbon footprint metric from more than only one source is also important to avoid inaccuracy (Jóhannesson et al., 2020). According to different experts and scientists, these changes would improve the metric by making it more accurate. Lastly, the metric also lacks warning about its users about its limitations and scope which would give the metric more credibility (J. van den Bergh & Verbruggen, 1998). Even when the EF has not been informed by new scientific knowledge by the original creators, others have used these new insights to adjust this metric and produce meaningful results of the Ecological Footprint. In this case, we can clearly see how co-production comes into play at adjusting calculations and metrics used to drive policy by incorporating scientific knowledge and research from environmental science (Li et al., 2022). Given the fact that other scientists have used scientific criticism to change the metric on their own, there is hope that other experts will take it into their own hands to calculate the EF with the new adjustments and produce more accurate numbers. In my opinion, it is not necessary to

completely change this metric since it is easy to understand and be used to drive environmental policy. Through this co-production analysis in can see the importance of incorporating science with society and guiding the policies, and laws using scientific knowledge as well as guiding scientific investigation around the metrics that are being used to change society. Since it is evident that the co-creator of the EF has received criticisms about the metric, but has not adjusted it to improve it.

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