The repercussions of sustainability: Fact or fiction

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Abstract: The author, a teacher by profession and practicing weekend farmer out of passion, observes the numerous reading materials published about various agricultural concerns. In addition, the worldwide web is a popular and accessible venue that feeds the craving for more materials regarding the same matters. Interestingly, online materials include videos and step-by-step instructions that guide aspiring as well as experienced farmers in their respective fields of interest, such as, the production of organic fertilizers or soil conditioners in the form of *bokashi* and *shivansh*, for examples.

Around the latter quarter of the last century, discussing and publishing about organic agriculture/farming along with its relatives, such as, compact or integrated farming, integrated pest management, sustainable agriculture, compost and vermicast production, among many others, became fashionable. Towards the end of the century up to the current time other concepts developed, such as, container and vertical farming; but, emphasis has shifted to the concept of sustainability that may include matters on urban agriculture/farming.

Sustainability and urban agriculture/farming are not new concepts at all. Both these terms have long been part of the farming jargon; and, their concepts have been continuously translated into practice. The concept of sustainability includes methods and practices preventing a natural asset (e.g., soil) from being completely used up (for example, refrain using chemical fertilizers and insecticides, consider using organic matter to preserve soil-life instead); or, it was used to mean the continued support of a particular family or community for a prolonged period. Urban farming, we are told, was practiced by refugees relocated to foreign lands as a strategy to augment their diet and income. In the Philippines, around the 1970's and during the Martial Law years, urban farming was encouraged by former President Marcos and his program was known as the "Green Revolution." At this point it is clear that sustainability includes urban agriculture (UA) or urban farming

If that is the case then why do we claim above that the emphasis at present has shifted to the concept "sustainability" including its sub-concept "urban agriculture/farming"? The emphasis we are referring to is inextricably attached to the difference between the way sustainability was understood then and the way it is in the present. We observe that understanding sustainability has become more engaging if not intellectually more challenging in the present. That is to say, the term has acquired a mega-status by virtue of its attachment to many other concepts referring to our planet's status, particularly its accelerating ecological decline, in relation to economics, technology, trade, urbanization, and the behavior and lifestyle of the city/urban dwellers of affluent countries most especially, among others.

The shift has another feature aside from the emphasis on the differing ways of understanding "sustainability" along with the concepts it carries, then and now. The shift also refers to the goal or purpose suggested—either explicitly or implicitly—in discourses dealing with sustainability. It is noticeable that the purpose of past discussions on sustainability was more pragmatic than anything else or the "how to" stuff together with the "why" that usually refer to soil conditioning and fertilization, lower expenses and safer or healthier produce. The other face of the goal or purpose shift that appears more recently is observed in this manner: Although the pragmatic feature is still present, some other feature keeps on appearing and returning as though knocking on the doors of humankind's conscience and soul. This refers to the ethical feature common to contemporary

discourses on sustainability. This development clearly portrays the qualitative change in the character of current sustainability talks from that of the previous ones.

Materials that purposely portray ethical features appear in different forms. One example particularly interesting and intellectually engaging is a work that deals with "metabolic rift" and its three senses—ecological rift, social rift, and individual rift discussed in the light of the ingenuities and thoughts of both Engels and Marx (See Nathan McClintock, "Why farm the city? Theorizing urban agriculture through a lens of metabolic rift" in Cambridge Journal of Regions, Economy and Society, 2010, 3, 191-207). For our purpose, however, the author chose an article insinuating a morbid end if the human species does not act as soon as it can. Despite the world's misery in terms of ecological deterioration, excessive carrying capacity/load, climate change, and the human-induced extinction of whole species, among others, the morbid end does not refer to the planet's demise but to the species fully capable of documenting the process of its own extinction—the human species.

The article, "Urban ecological footprints: Why cities cannot be sustainable—and why they are a key to sustainability" is one well written by both William Rees and Mathis Wackernagel (Environ Impact Assess Rev 1996: 16: 223-248). The title of our discussion is inspired by their article that manifests the truly ethical feature that we spoke about above. The article narrates a complicated story that begins with the origin of urbanization, the effects of economics, technology, and trade, for examples, on sustainability issues, such as, ecological dysfunction. It reminds humankind, specifically urban dwellers of affluent states, regarding the inconsiderate and wasteful use of the earth's resources that are returned to nature in the form of waste leaving nothing in the process for future generations to enjoy and utilize. Our thesis, thus, echoes the concern of our main source written by both Rees and Wackernagel and responds to the title of our discussion—The repercussions of sustainability: Fact or fiction—is stated as: Unless plans and policies promoting sustainability are enforced to heal our planet's ecological disorder, sustainability will remain as a fictional concept. And being the case, sustainability will never attain the status of being a fact, therefore, the inevitable conclusion follows: Our planet will eventually exceed its "carrying capacity" or "maximum human load" ten-, twenty-, fifty-, even a hundred-fold. Clearly, this leads to the self-induced extinction of humankind.

Key Words: Ecological footprint; Carrying capacity; Sustainability; Entropy; Urbanization

Introduction

The abundance of plants and trees surrounding the provincial abode where I grew up as a kid motivated my deep interest in agriculture. One wakes up every morning to the chirping of birds and crowing of roosters. On cool days, at dusk, one hears the sounds from crickets among the trees; and on rainy days and nights, frogs are continuously croaking. The town market is literally a showroom displaying crabs, fishes, shrimps, and other different forms of marine life. For the past two or three decades, however, all these significantly changed.

The planting urge I had held since childhood was only realized while pursuing graduate studies in the early 80s. My first project was planting a hundred seedlings of carabao mangoes—the "Super Manila" variety—as my birthday gift to my late mom in 1986. Most of these perished due to my total dependence on rainfall and refusal to use chemical fertilizers. Some others were destroyed by strong typhoon winds and a few were hit by lightning. Only two dozens survive today as thirty-year old trees. In the 90s I tried cultivating lumber trees and the results were better except for the longer time it takes them to mature. Since then I do my best farming on weekends despite my heavy schedule and responsibility as an educator.

Nowadays, there is an abundance of reading materials published via agriculture magazines and the worldwide web. Online materials are more accessible, thus, more popular. These online publications are interesting because they include readings, pictures, and videos along with step-by-step instructions that guide both aspiring and experienced farmers in their respective fields of interest, such as, organic fertilizer and soil conditioner production in the form of "bokashi" and "shivansh," for examples.

Around the latter part of the last century, discussions and publications about organic agriculture/farming along with its relatives like compact or integrated farming, integrated pest management, sustainable agriculture, compost and vermicast production, etc. became fashionable. Towards the end of the century up to the current time other concepts developed like container and vertical farming methods; but, the **emphasis** shifted to the concept of sustainability coupled with urban agriculture/farming.

The concepts "sustainability" and "urban agriculture/farming" are not new at all. Both have long been part of the agriculture/farming jargon; and, attempts were always made to translate these concepts into practice. The concept of **sustainability** includes methods and practices preventing a natural asset (e.g., soil) from being completely used up (for example, refrain using chemical fertilizers and insecticides, instead consider organic matter and natural means to preserve or extend soil life and control pests, respectively); or, the term is used to mean the continued support of a particular family or community for a prolonged period.

The early manifestation and practice of urban farming was observed as a common activity among refugees relocated to foreign lands. Primarily, this activity improves their diet requirements and helps them partake in recipes they are used to back in their native lands. Also, they increase their income by selling whatever surplus they have.

The Philippines had its own version of urban farming during the Martial Law years in the 1970s. Aside from the Vietnamese refugees who were either permanently or temporarily relocated here after the Vietnam War, Filipino urban dwellers practiced urban farming as well. This activity was through the initiative of former President Ferdinand E. Marcos. His program called the "Green Revolution" was implemented through the aid and efforts of Barangay officials. These officials encouraged urban dwellers in their respective areas to cultivate and plant in their backyards and vacant lots within the city proper and nearby suburbs. It appears that the purpose of President Marcos' Green revolution program was the family's sustenance. So, herein, sustainability includes and goes together with urban farming.

Why then do we claim above that the emphasis at present has shifted to the concept "sustainability" along with its ally- or sub-concept urban agriculture/farming? The emphasis we are referring to is attached to the difference between the way sustainability was understood then and the way scholars and writers wish us to understand it today. Today, discourses on sustainability are more engaging and intellectually more challenging. The term has acquired a mega-status by virtue of its attachment to many other concepts referring to planet Earth's condition, particularly its accelerating ecological decline, in relation to economics, technology, trade, urbanization, and the behaviour and lifestyle of the city/urban dwellers of affluent countries.

The shift has another feature aside from the emphasis on the differing ways of understanding "sustainability" along with the concepts it carries then and now. The shift also refers to the goal or purpose suggested—either explicitly or implicitly—in discourses regarding sustainability. It is noticeable that the purpose of past discussions was more pragmatic than anything else or the "how to" stuff together with the "why" that usually refer to soil conditioning and fertilization, lower expenses, and safer or healthier produce. The other face of the goal or purpose appearing more recently is observed in this manner: Although the pragmatic feature is still present, some other feature keeps on appearing and returning as though knocking on the doors of humankind's conscience and soul. This refers to the ethical feature common to contemporary discourses on sustainability. This development clearly portrays the qualitative change in the character of current sustainability talks as compared to previous ones.

Materials that purposely portray ethical features appear in different forms. One example particularly interesting and intellectually engaging is a work that deals with "metabolic rift" and its three senses—ecological rift, social rift, and individual rift discussed in the light of the ingenuities and thoughts of both Engels and Marx (See Nathan McClintock, "Why farm the city? Theorizing urban agriculture through a lens of metabolic rift" in Cambridge Journal of Regions, Economy and Society, 2010, 3, 191-207). For our purpose, however, we chose an article insinuating a morbid end if the human species does not act the way it should as soon as it can. Despite the world's misery in terms of ecological deterioration, excessive carrying capacity/load, climate change, and the human-induced extinction of whole species, among others, the morbid end does not refer to the planet's demise but to the species fully capable of documenting the process of its own extinction—the human species.

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Discussion

The article of both Rees and Wackernagel begins with their story narrating how **human ecology**—the science dealing with relationships between groups of living organisms and their environment—transformed in the last century. They describe the industrial revolution as the time when the "greatest human migration in history" occurred. The migration of human beings continues and is in the process of transforming the world's continents, such as, Asia. **Migration**, for our authors, refers to the "mass movement of people from farms and rural villages to cities everywhere." Thus, they describe the current world as an "urban world." "[Seventy-five percent] or more of the people in ... industrialized countries now live in towns and cities, and half of humanity will be city dwellers by the end of the century" which was seventeen years ago and going eighteen! Simply told, this is "**urbanization**."

For both authors urbanization is usually seen as an "economic or demographic phenomenon" (the statistical study of human populations especially with respect to size, density, and distribution that occur over a period of time); and, represents a "human ecological transformation." The transformation they are referring to is the "dramatic shift in human spatial and material relationships with the rest of nature." Understanding this transformation is necessary for the purposes of sustainability. If we attempt to relate urbanization with sustainability, the appropriate question we are to ask is: How can we assess the ecological role of cities and how can we estimate the scale of their impact on the ecosphere? To answer this, both authors propose to utilize the **ecological footprint estimate**. Their analysis clearly suggest that cities, "as nodes of energy and material consumption...are causally linked to accelerating global ecological decline and are not by themselves sustainable. At the same time, cities and their inhabitants can play a major role in helping to achieve global sustainability." This seems the closest reason why they title their article as such.

The analysis on cities above is derived from some premises both Rees and Wackernagel start with. They say:

> [The] late 20th century marks a nontrivial turning point in the ecological history of human civilization. For the first time since the dawn of agriculture and the possibility of geographically fixed settlements 12,000 years ago, the aggregate scale of human activity is capable of altering global biophysical [the scientific study concerned with the application of physical principles and methods to biological problems] systems and processes in ways that jeopardize both global ecological stability and geopolitical [The study of how geography and economics influence the politics and relations between nations] security.

They continue by citing various examples:

> [More] artificial nitrate is now applied to the world's croplands than is fixed from the atmosphere by microbial activity and other natural processes combined; the rate of human-induced species extinctions is approaching the extinction rates driven by 'the great natural catastrophes at the end of the Paleozoic and Mesozoic era—in other words, they are the most extreme in the past 65 million years; 'residuals' discharged by industrial economies are depleting stratospheric ozone and altering the preindustrial composition of the atmosphere, and both these trends contribute to (among other things) the threat of climate change, itself the most potent popular symbol of widespread ecological dysfunction. Perhaps most significant from an ecosystems perspective is the evidence that human beings, one species among millions, now consume, divert, or otherwise appropriate for their own purposes 40% of the product of net terrestrial photosynthesis and up to 35% of primary production from coastal

> shelves and upwellings, the most productive marine habitats. Were it not for the fact that fish catches are in decline from stock depletion, both these proportions would be steadily increasing.

To summarize: Both Rees and Wackernagel establish the relation between human economic activity—desire for higher and stable income that result to migration, thus, urbanization and industrialization, depleting supply and availability of resources that has to address increasing demand of the rising population—and grave ecological concerns—waste production and disposal problems, atmospheric ozone damage, and climate change. All these ecological concerns, among others, all point out to one end-result called ecological dysfunction. The only hope and optimistic approach is to make certain that ideas concerned with sustainability, including urban farming, are realized through sincere efforts of urban dwellers now comprising 50% of the world's population.

Our information above leads to one concept that can, hopefully, motivate people unaware of and unconcerned with the grave ecological dysfunction. This is called the **carrying capacity** concept, also known as the "**maximum human load**." By definition, it is the "maximum population of a given species that can be supported indefinitely in a defined habitat without permanently impairing the productivity of that habitat." Simply, it is the environment's maximum load that it can persistently support. We cannot help thinking that Earth's maximum load has already been reached; at best, about to be reached. This reminds us of at least two things: One, the world's resources are not infinite as many think; and, the other, we remember lessons from Thomas Robert Malthus that only begin to make a lot of sense today.

Malthus is an English cleric and scholar, one among the best known economists along with Adam Smith and David Ricardo. Basically, Malthus was concerned with the balance between population that increases exponentially and food supply that increases arithmetically. He spoke of two "checks" that can balance population and food supply. One he calls "preventive checks" or moral constraints in the forms of sexual abstinence, delaying marriage, and restricting marriage to impoverished and "defective" people. The other he calls "positive checks." These come in the form of premature deaths, such as, disease, starvation, and war. We may include accidents too if we wish. Though Malthus never used the carrying capacity concept to express his point, he obviously was concerned with the same matter and predicament that "carrying capacity" is all about—population and food supply. He also insinuates about sustainability when he says positive checks lead to what is now termed as the "Malthusian catastrophe" that returns population to a lower and sustainable level.

Rees and Wackernagel point out that human beings appear capable of "continuously increasing [the Earth's] human carrying capacity by eliminating competitive species, importing locally scarce resources [and exporting surplus—that is, through trade], and through technology." Because of our capacity to increase carrying capacity the common economists and planners disregard that concept as applicable to human beings. Our authors quote Herman Daly who critically reacts to this and says, "[The] prevailing vision assumes a world in which the economy floats free of any environmental constraints. This is a world 'in which carrying capacity is infinitely expandable' and therefore irrelevant." On the contrary, Daly holds that "the economy is a wholly owned subsidiary of the environment, not the reverse." Rees and Wackernagel agree with Daly when they claim that "the economy is an inextricably embedded subsystem of the ecosphere."

Human beings "[remain] in a state of 'obligate dependence' on the productivity and life support services of the ecosphere [despite their technological and economic achievements]." Being biophysical entities, humans acquire nourishment just like other consumer species that they co-inhabit the planet with. Common to all of them is the biological metabolism they possess. In addition to that, the human project includes an industrial metabolism and that is the significant difference between them. Rees and Wackernagel tell us the following:

> We depend for both basic needs and the production of cultural artifacts on energy and material resources extracted from nature, and *all* this energy/matter is eventually returned in degraded form to the ecosphere as waste…In thermodynamic terms, all our toys and tools (the human-made 'capital' of economists) are 'the exosomatic [external to the body] equivalent of organs' and like bodily organs, require continuous flows of energy and material to and from 'the environment' for their production and operation. Carrying capacity therefore remains central to sustainability.

Aside from the carrying capacity concept, there is another insight that provides an understanding of sustainability. This is called the "**capital theory approach**." Together with this approach is a new jargon

introduced by today's ecological economists. They no longer consider "the species, ecosystems, and other biophysical entities [or, natural resources] [producing] required resource flows as mere 'free goods of nature' but forms of 'natural capital'; and, the [resource] flows [produced] as types of essential 'natural income'." Because natural capital produce required resource flows—natural income—these are likewise called "productive capital." The capital theory approach teaches us "that no development path is sustainable if it depends on the continuous depletion of productive capital." This view implies that "society [is said] to be economically sustainable only if it passes on an undiminished per capita stock of essential capital from one generation to the next." This is called the "constant capital stocks criterion." From here, we gather that the capital theory approach includes the **constant capital stocks criterion**.

Rees and Wackernagel give us the most relevant interpretation of this criterion in this manner: "Each generation should inherit an adequate per capita stock of natural capital assets no less than the stock of such assets inherited by the previous generation." They clarify further by saying that "natural assets [encompass] not only material resources (e.g., petroleum, the ozone layer, forests, soil) but also process resources (e.g., waste assimilation, photosynthesis, soil formation). It includes renewable as well as exhaustible forms of natural capital. Our primary interest here is in essential renewable and replenishable forms. Note that the depletion of nonrenewables could be compensated for through investment in renewable natural capital."

The details above now lead us back to sustainability along with a distinction made. The distinction between "**strong sustainability**" and "**weak sustainability**" is a consequence of interpreting the constant capital stocks criterion. Strong sustainability emphasizes on "maintaining natural (biophysical) capital intact" while the other interpretation calls for maintaining "a constant *aggregate* stock of [human-made] and natural assets." This version alleges that human-made or manufactured capital or asset can replace the natural one. Again, the authors cite Daly's opinion suggesting that one is not meant to substitute for the other; rather, their relation should be perceived as complementary. Rees and Wackernagel explain that "many forms of biophysical capital perform critical functions that cannot be replaced by technology. For sustainability, a critical minimal amount of such capital must be conserved intact and in place. This will ensure that the ecosystems upon which humans depend [on] remain capable of continuous self-organization and production." Furthermore, they clarify that constant stocks should not be taken to mean anything else aside from constant *physical* stocks; not in terms of monetary equivalence. They make this clear by stating that the "only ecologically meaningful interpretation of constant stocks is in terms of constant *physical* stocks as is implied here. However, some economists interpret 'constant capital stock' to mean constant monetary value of stocks or constant resource income over time … [This interpretation allows] declining physical stocks as value and market prices rise over time."

The issue at hand for our authors regarding ecological sustainability that needs to be resolved is "whether remaining *natural* capital stocks (including other species populations and ecosystems) are adequate to provide the resources consumed and assimilate the wastes produced by the anticipated human population into the next century, while simultaneously maintaining the general life support functions of the ecosphere." Simply placed, is the human carrying capacity adequate or sufficient? Rees and Wackernagel say: "At present, of course, both the human population and average consumption are increasing, whereas the total area of productive land and stocks of natural capital are fixed or in decline. In this light, we argue that shrinking carrying capacity may soon become the single most important issue confronting humanity."

We now reach the very interesting but alarming part of our discussion. Rees and Wackernagel here try altering the definition of one concept we are already familiar with, the human carrying capacity concept. To recap: By definition, that concept is the maximum population of a given species that can be supported indefinitely in a defined habitat without permanently impairing the productivity of that habitat or the maximum human load that an environment can persistently support. In the present, as already implied, sustainability is closely associated to the Earth's miserable state called ecological dysfunction. In that light, both authors opine that their issue above—whether natural capital stocks are adequate in providing resources consumed and capable of assimilating wastes produced by the expected human population in the future—can be better resolved if the human carrying capacity concept is redefined. They propose that maximum human load should not be perceived as the maximum population but as the "maximum (entropic) 'load' that can be safely imposed on the environment by people." Entropic load refers to the degradation or disorder that the Earth or ecosphere takes or is subjected to.

Together with entropic load is the observation that human load itself is not a function of population alone; rather, it is also a function of the average per capita consumption, that is, the equal consumption for each and

every individual in a particular area, such as a city or country. Rees and Wackernagel say "the latter [average per capita consumption] is increasing even more rapidly than the former [population] due (ironically) to expanding trade, advancing technology, and rising incomes." They further add quoting another author who says: "The world is being required to accommodate not just more people, but effectively 'larger' people…" Consider this example, "in 1790 the estimated average daily energy consumption by Americans was 11,000 kcal per capita. By 1980, this had increased almost 20-fold to 210,000 kcal per capita." This shows that human carrying capacity is not a function of population alone.

In effect, what they are doing is extending the concept of load. In addition, they invert the carrying capacity ratio and develop what they believe is a "powerful tool for assessing human carrying capacity. The conventional question we asked when considering carrying capacity is "what [is the] population a particular region can support sustainably?" By inverting the carrying capacity ratio, Rees and Wackernagel now ask, "How large an area of productive land is needed to sustain a defined population indefinitely, *wherever on Earth that land is located*?" Instead of being concerned primarily about population relative to land requirement for sustainable support, they now restate the question giving importance to the productive land area, anywhere on Earth, necessary to sustainably support a given population. By doing this, they illustrate that population is not primary in sustainability talks; rather, it is natural or productive capital along with its product called natural income. They say:

> Since most forms of natural income (resource and service flows) are produced by terrestrial ecosystems and associated aquatic ones, it should be possible to estimate the area of land/water required to produce sustainably the quantity of any resource or ecological service used by a defined population or economy at a given level of technology. The sum of such calculations for all significant categories of consumption would provide a conservative area-based estimate of the natural capital requirements for that population or economy. We call this area the population's true **ecological footprint**. [bold mine]

To portray the ecological principles behind this approach, they invite us to do a mental experiment. First, they ask us to imagine what happens to any modern city defined by its political boundaries if it were enclosed in a glass or plastic hemisphere and completely closed to material flows. The people within can only depend on whatever remnant ecosystems trapped within the hemisphere. The city will fail to function and its inhabitants will perish. "The population and economy contained by the capsule would have been cut off from both vital resources and essential waste sinks leaving it to starve and suffocate at the same time. In other words, the ecosystems contained within" this imaginary city will have a carrying capacity insufficient in addressing the ecological load imposed by the population.

Next, they invite us to think of an actual city's ecological reality and assume that it is surrounded by a diverse landscape, such as croplands, pastures, forests, watersheds, and all other productive land-types proportionate to their actual abundance on Earth. We can include adequate fossil energy enough to support current levels of consumption including technology. Their question now is: "How large would the hemisphere have to grow before the city at its center can sustain itself indefinitely and exclusively on the land and water ecosystems and the energy resources contained within the capsule?" The answer to that question will be an actual estimate of the city's ecological footprint. Thus, ecological footprint (EF) is defined as "the total area of productive land and water required continuously to produce all the resources consumed and to assimilate all the wastes produced, by a defined population, wherever on Earth that land is located."

We will do away with the mathematical calculations in the interest of space and time; and, will consider a few examples instead to make us aware of how extravagant human beings are especially the residents of the affluent countries. Let us start by asking, what is the area of a productive forest necessary to provide pulp-wood for paper used by the average Canadian? We are told that each Canadian consumes about 244 kilos of paper products each year. In addition to recycled paper the production of each metric ton of paper in Canada requires 1.8 m3 of wood. Their calculations reveal that the average Canadian requires 0.19 ha/capita (i.e., 1,900 m2/capita) of forest in continuous production of paper. A similar calculation can also be made for the required land area to assimilate specific individual wastes like carbon dioxide.

The total average per capita ecological footprint (ef) is compiled by adding up all the ecosystem areas required by an individual to fill up one's annual shopping basket of consumption goods and services. By multiplying the average per capita ecological footprint with total population size (N) we obtain the ecological footprint of the entire population (EFp). So, EFp = N x ef.

The appeal of the ecological footprint analysis is its conceptual simplicity. It is easy to grasp. The advocates, Rees and Wackernagel, tell us more about ecological footprint analysis:

> It aggregates the ecological flows associated with consumption and translates them into land area, an indicator that anyone can understand. The ecological footprint of any defined population can then be compared with the available supply of productive land. Individuals can contrast their personal footprints with their ecological "fair Earthshares," national footprints can be compared to domestic territories, and the aggregate human footprint can be compared to the productive capacity of the entire planet.
> In cases where the ecological footprint is significantly larger than a secure supply of productive land, the difference represents a 'sustainability gap' and 'ecological deficit'. This is the amount by which consumption must be reduced for long-term ecological sustainability … The question then becomes: How large is our ecological deficit and what must be done to reduce it?
> Ecological footprinting acts … as an ecological camera—each analysis provides a snapshot of our current demands on nature, a portrait of how things stand *right now* under prevailing technology and social values. We believe that this in itself is an important contribution. We show that humanity has exceeded carrying capacity and that some people contribute significantly more to this ecological 'overshoot' than do others. [It] also estimates how much we have to reduce our consumption, improve our technology, or change our behavior to achieve sustainability.

There is a strong sense of urgency today to achieve sustainable levels. Some examples our authors give help in calling our attention. Canada is one of the wealthiest countries and its citizens enjoy very high material standards. Ecological footprint (EF) analysis reveals that the total land required to support present consumption levels by the average Canadian is at least 4.3 hectares, including 2.3 hectares for carbon dioxide assimilation alone. Therefore, the per capita EF of Canadians—their "personal planetoid"—is almost three times their "fair Earthshare" of 1.5 hectares—the land area allocated for each of us on Earth (total area of *assumed* productive land/water ecosystems divided by Earth's population). Take Vancouver in particular: It has an area of 11,400 hectares and a population of 472,000 in 1991. If the assumed per capita land consumption is 4.3 hectares, then the people in Vancouver alone will require 2 million hectares to maintain their current consumption patterns or almost 180 times its political area. In London's case, estimates suggest that its EF for food, forest products, and carbon assimilation is 120 times its area. Japan has a 2.5 ha/capita so its national EF is about 8 times larger than its area; Holland has a 3.3 ha/capita so its national EF is about 15 times its domestic territory. These examples from our authors tell us that all these cities and countries "overshot" the terrestrial carrying capacity of their home territory: Vancouver by a factor of 180; London by 120; Japan by 8; and, Holland by 15.

This tells us that world leaders and institutions obsessed with economic development should not focus on GDP growth alone; but, must consider including ecological development as well. The land/water and waste assimilation requirements many times the geographical areas of cities and highly urbanized countries is a result of excessive energy and material consumption brought about by heavy dependence on technology and international trade. Consumption is no longer proportional to the natural income or products within their boundaries. That means, "*no city or urban region can achieve sustainability on its own*" but must depend or "appropriate" its needs on other territories not necessarily nearby and, thus, deprive and exploit other areas especially the rural ones. Migration to urban areas does not mean rural areas are abandoned; on the contrary, "rural lands and ecosystem functions are being exploited more intensely … in the service of newly urbanized human populations."

If we stand along with our authors, that 75% or more of the population in advanced and high-income countries comprising about 25% of all countries and 50% of the world population are residing in urban areas, then we will have to concur with the Brundtland Commission's estimate, as our authors do, that "the wealthy quarter of the world's population consume over three-quarters of the world's resources (and therefore produce at least 75% of wastes)." That means, residents of "wealthy cities are responsible for about 60% of current levels of resource depletion and pollution."

After giving all these information we have to ask, "What reputation do cities have for both Rees and Wackernagel? For them, cities are "entropic black holes." They take in energy and matter from the ecosphere

and returning all of it back to the ecosphere in degraded form. Cities are subject to the forces of entropic decay, having the tendency to erode and dissipate. But more important is this: Cities in these current times do not appear to be decaying at all. This is because available energy and material can still be imported from their hosts. They put these into use to maintain their "internal integrity." In return cities export the resultant entropy—waste and disorder—to their hosts. This is because the urban system degrades and dissipates available energy and matter from hosts, thus, cities are "dissipative structures."

This suggests that all cities, including the human economy therein, can only be sustainable within the load-bearing capacity of the ecosphere. If cities along with its residents continue to abuse the ecosphere's load-bearing capacity, time will come when economists and planners will have to measure or compute the cost of economic growth in terms of increasing entropy or dysfunction in the ecosphere. Currently, human consumption has exceeded the amount of available natural income as illustrated by the "continuous depletion of natural capital—reduced biodiversity, fisheries collapse, air/water/land pollution, deforestation, desertification, etc." Our authors cite World Bank ecologist Robert Goodland who uses the current condition of the ecosphere to argue that "current throughput growth in the global economy cannot be sustained." Both Rees and Wackernagel agree with him and add that "we have already reached the entropic limit to growth."

Productive land "available" to each one of us is consistently decreasing rapidly along with the continuous population increase of "larger people." As pointed out above only 1.5 hectares of productive land is "available" to each one of us, "including wilderness areas that probably [should not] be used for any other purpose." Together with this is the steady increase in the land area requirement of affluent cities and countries. We are told that the per capita EF of North Americans is 4 to 5 hectares, three times their fair Earthshare. Imagine "if everyone on Earth lived like the average North American, the total land requirement [exceeds] 26 billion hectares." That means, we will need 3 Earths or planets to support the current human population since ours only has less than 9 billion hectares.

To summarize, Rees and Wackernagel write:

> … to the extent that competitive open global markets and liberated trade accelerate the depletion of essential natural capital, it is counterproductive to sustainability. Trade only appears to increase carrying capacity. In fact, by encouraging all regions to exceed local limits, by reducing the perceived risk attached to local natural capital depletion, and by simultaneously exposing local surpluses to global demand, uncontrolled trade accelerates natural capital depletion, reducing global carrying capacity and increasing the risk to everyone.

Conclusion

Above, we gather that cities cannot be sustainable at all. If the current conditions persist just so the internal integrity of cities and affluent, highly urbanized countries can be maintained then all lectures and publications on sustainability will simply be a good reason to get involved in intelligent discourse and a way to let time pass. In that case, sustainability remains as a pure concept, a fiction. That is not our goal. We have shown some data illustrating ecological dysfunction soliciting an urgency to do something in realizing sustainability and make it a fact.

Urban policy makers and planners, including world leaders, have to start working to minimize the degradation and depletion of ecosystems processes, reduce energy and material consumption, wastages, and excessive behavior and lifestyles, typically associated with cities and wealthy countries. As quoted by Rees and Wackernagel, the Business Council on Sustainable Development holds that "industrial world reductions in material throughput, energy use, and environmental degradation of over 90% will be required by 2040 to meet the needs of a growing world population fairly within the planet's ecological means." Many authorities share this view, they add; but, we say why wait for 23 years more when we can actually start now?

In addition to that, populations and consumption are concentrated in cities bringing about unfavorable ecological impacts. These impacts can be less severe and minimized if city and urban planners find ways to establish dispersed settlements along with the improvement of public and mass transport systems. This will not be possible for old cities but can be feasible for new ones. Perhaps, city and national policy makers can prevent

new industrial and production plants within the city-proper and then give ample time for plants established long ago within the city to move elsewhere. All the garbage produced by urban residents together with various pollutants from industrial and production plants are dangerous upon reaching particular levels. The garbage and pollutants may be better assimilated, disposed, and diluted in a more dispersed environment.

Finally, the most important considerations or proposals is: International sustainability efforts and plans cannot be possible without international agreement and cooperation. A common goal for countries, especially the affluent ones, should be self-sufficiency. Being self-sufficient does not mean being closed to the world. The least that can be done for starting is to encourage developing their respective productive capitals. Instead of the natives selling their potentially productive lands to developers, they should be encouraged (or be given incentives even) to develop these under some sustainability program that addresses a forthcoming or urgent concern. For us individuals, in our own little corners, we can develop conservation and recycling habits, shunning anything excessive, self-discipline and cooperation among all of us in realizing one goal—sustainable ecosystems, and be considerate to future generations, ourselves, and the Earth.

At this time, we cannot hope for the best; things will only work out for the better if we do something in concrete terms. If we don't, then the morbid end is to be expected as a forthcoming certainty. The morbid end does not refer to the planet's demise but to the species fully capable of documenting the process of its own extinction—the human species. In the words of our authors, "humans may well become the first species to document in exquisite detail the factors leading to its own demise."