# Sustainability: Human, Social, Economic and Environmental

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*The four main types of sustainability are human, social, economic and environmental. These are defined and contrasted in Tables 1–4. It is important to specify which type of sustainability one is dealing with as they are all so different and should not be fused together, although some overlap to a certain extent. Specialists in each field best deal with these four types of sustainability. For example, social scientists have a lot to say about social sustainability; economists deal with economic sustainability and biophysical specialists deal with environmental sustainability.*

A definition of environmental sustainability (ES) has been given by Daly (1973, 1974, 1992, 1996, 1999) and Daly and Cobb (1989):

1. Output rule: Waste emissions from a project or action being considered should be kept within the assimilative capacity of the local environment, without unacceptable degradation of its future waste absorptive capacity or other important services.
2. Input rule:
    - Renewable resources: (e.g., forest, fish) harvest rates of renewable resource inputs must be kept within regenerative capacities of the natural system that generates them.
    - Non-renewables: depletion rates of non-renewable resource inputs should be set below the historical rate at which renewable substitutes were developed by human invention and investment according to the Serafian quasi-sustainability rule (see below). An easily calculable portion of the proceeds from liquidating non-renewables should be allocated to the attainment of sustainable substitutes.

## SERAFIAN QUASI-SUSTAINABILITY RULE OF NON-RENEWABLES

The Serafian rule pertains to non-renewable resources, such as fossil fuels and other minerals, but also to renewables to the extent they are being mined. It states that their owners may enjoy part of the proceeds from their liquidation as income, which they can devote to consumption. The remainder, a user cost, should be reinvested to produce income that would continue after the resource has been exhausted. This method essentially estimates income from sales of an exhaustible resource. It has been used as a normative rule for quasi-sustainability, whereby the user cost should be reinvested, not in any asset that would produce future income, but specifically to produce renewable substitutes for the asset being depleted. The user cost from depletable resources has to be invested specifically in replacements for what is being depleted in order to reach sustainability, and must not be invested in any other venture – no matter how profitable. For non-renewable energy, a future acceptable rate of extraction of the non-renewable resource can be based on the historic rate at which improved efficiency, substitution and re-use became available. These calculations show the folly of relying on technological optimism, rather than on some historic track record.

## CAUSES OF UNSUSTAINABILITY

When the human economic subsystem was small, the regenerative and assimilative capacities of the environment appeared infinite. We are now painfully learning that environmental sources and sinks are finite. Originally, these capacities were very large, but the scale of the human

**Table 1** Comparison of Human, Social, Economic and Environmental Sustainability: Human Sustainability

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| • Human sustainability means maintaining human capital. Human capital is a private good of individuals, rather than between individuals or societies. The health, education, skills, knowledge, leadership and access to services constitute human capital. Investments in education, health, and nutrition of individuals have become accepted as part of economic development |
| • As human life-span is relatively short and finite (unlike institutions) human sustainability needs continual maintenance by investments throughout one's lifetime |
| • Promoting maternal health and nutrition, safe birthing and infant and early childhood care fosters the start of human sustainability. Human sustainability needs 2–3 decades of investment in education and apprenticeship to realize some of the potential that each individual contains. Adult education and skills acquisition, preventive and curative health care may equal or exceed formal education costs |
| • Human capital is not being maintained. Overpopulation is intensifying and is the main dissipative structure worsening per capita indices. That is far graver than overcapitalizing education so that laborers have PhDs |

**Table 2** Comparison of Human, Social, Economic and Environmental Sustainability: Social Sustainability

- Social sustainability means maintaining social capital. Social capital is investments and services that create the basic framework for society. It lowers the cost of working together and facilitates cooperation: trust lowers transaction costs. Only systematic community participation and strong civil society, including government can achieve this. Cohesion of community for mutual benefit, connectedness between groups of people, reciprocity, tolerance, compassion, patience, forbearance, fellowship, love, commonly accepted standards of honesty, discipline and ethics. Commonly shared rules, laws, and information (libraries, film, and diskettes) promote social sustainability
- Shared values constitute the part of social capital least subject to rigorous measurement, but essential for social sustainability. Social capital is undercapitalized, hence the high levels of violence and mistrust
- Social (sometimes called moral) capital requires maintenance and replenishment by shared values and equal rights, and by community, religious and cultural interactions. Without such care it depreciates as surely as does physical capital. The creation and maintenance of social capital, as needed for social sustainability, is not yet adequately recognized. Western-style capitalism can weaken social capital to the extent it promotes competition and individualism over cooperation and community
- Violence is a massive social cost incurred in some societies because of inadequate investment in social capital. Violence and social breakdown can be the most severe constraint to sustainability

**Table 3** Comparison of Human, Social, Economic and Environmental Sustainability: Economic Sustainability

- Economic capital should be maintained. The widely accepted definition of economic sustainability is maintenance of capital, or keeping capital intact. Thus Hicks's definition of income–the amount one can consume during a period and still be as well off at the end of the period–can define economic sustainability, as it devolves on consuming value-added (interest), rather than capital
- Economic and manufactured capital is substitutable. There is much overcapitalization of manufactured capital, such as too many fishing boats and sawmills chasing declining fish stocks and forests
- Historically, economics has rarely been concerned with natural capital (NC) (e.g., intact forests, healthy air). To the traditional economic criteria of allocation and efficiency must now be added a third, that of scale (Daly, 1992). The scale criterion would constrain throughput growth–the flow of material and energy (NC) from environmental sources to sinks
- Economics values things in money terms, and has major problems valuing NC, intangible, intergenerational, and especially common access resources, such as air. Because people and irreversibles are at stake, economic policy needs to use anticipation and the precautionary principle routinely, and should err on the side of caution in the face of uncertainty and risk

**Table 4** Comparison of Human, Social, Economic and Environmental Sustainability: Environmental Sustainability (ES)

- Although ES is needed by humans and originated because of social concerns, ES itself seeks to improve human welfare by protecting NC. As contrasted with economic capital, NC consists of water, land, air, minerals and ecosystem services, hence much is converted to manufactured or economic capital. Environment includes the sources of raw materials used for human needs, and ensuring that sink capacities recycling human wastes are not exceeded, in order to prevent harm to humans
- Humanity must learn to live within the limitations of the biophysical environment. ES means NC must be maintained, both as a provider of inputs (sources), and as a sink for wastes. This means holding the scale of the human economic subsystem (= population $\times$ consumption, at any given level of technology) to within the biophysical limits of the overall ecosystem on which it depends. ES needs sustainable consumption by a stable population
- On the sink side, this translates into holding waste emissions within the assimilative capacity of the environment without impairing it
- On the source side, harvest rates of renewables must be kept within regeneration rates
- Technology can promote or demote ES. Non-renewables cannot be made sustainable, but quasi-ES can be approached for non-renewables by holding their depletion rates equal to the rate at which renewable substitutes are created. There are no substitutes for most environmental services, and there is much irreversibility if they are damaged

economy has exceeded them. Source and sink capacities have now become limited. As economics deals only with scarcities, in the past source and sink capacities of the environment did not have to be taken into account. Conventional economists still hope or claim that economic growth can be infinite or at least that we are not yet reaching limits to growth.

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