Essay

Globalisation: Effects on Biodiversity, Environment and Society

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The march of globalisation seems inexorable, with effects felt throughout the world. These effects include, but are not limited to, reduced genetic diversity in agriculture (loss of crop varieties and livestock breeds), loss of wild species, spread of exotic species, pollution of air, water and soil, accelerated climatic change, exhaustion of resources, and social and spiritual disruption. The market cannot be relied on to control the environmental and other costs of globalisation. Although its present dominance creates an impression of permanence, a conjunction of formidable limiting factors is even now acting to curb the process of globalisation—possibly to end it altogether. Technological fixes cannot overcome these limiting factors. The architects of globalisation have ignored the social, biological and physical constraints on their created system. Critics of globalisation have noted that global free trade promotes the social and economic conditions most likely to undermine its own existence. The same can be said of the biological and physical limiting factors—especially, in the short term, the dwindling supplies of cheap energy. The necessary opposition that has formed to counter the worst features of globalisation must keep its dangerous side-effects in the public eye, and develop alternative, workable socio-economic systems that have a strong regional element and are not dependent on centralised, complex technologies.

Introduction

Globalisation, a term that was used infrequently before the 1990s, is now in common parlance. It refers primarily to an economic system in which raw materials, manufactured goods, intellectual property and financial transactions

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flow freely (although not equally) across international borders under the supervision only of an international trade authority. It also refers to the homogenisation of language and cultural identity that accompanies this flux of material, ideas and money. Despite its growing strength, the side effects of this pervasive economic strategy remain poorly understood, perhaps because the great majority of them are indirect. This is especially true of the environmental effects. The march of globalisation is often described as inexorable, leading to a final state in which a few, very large corporations dominate world commerce, under the regulation not of nation states but one or a small number of regulatory bodies. These bodies are not run by statesmen, jurists or ecologists, but by economists whose viewpoints harmonise with those of the multinationals they regulate.

The spread of globalisation has been so rapid and comprehensive that its effects are being felt in the smallest and most remote human communities and natural areas in both developed and undeveloped countries. Indeed, the words 'developed' and 'undeveloped' assume a direction and inevitability of change towards a uniform economic condition that leaves no alternatives. Nevertheless, it would be unwise to accept the assumption that globalisation as an economic system is here to stay, although many of its more profound environmental consequences are likely to prove extremely long-lasting. Immense power always creates an impression of permanence, but a conjunction of formidable limiting factors is even now acting to curb and modify the process of globalisation—perhaps to end it altogether.

In this article, I first describe the principal biological, environmental, social and spiritual effects of globalisation, then discuss the limiting factors that are likely to alter its course and the actions that will have to be taken to maintain the stability of both environment and society.

The Effects of Globalisation

Nobody knows all of the environmental and social effects of globalisation. The following listing is necessarily incomplete and brief. I have devoted the most space to the biological effects of globalisation. Items are in no particular order.

Loss of Biodiversity

Reduced Genetic Diversity in Agriculture A profound reduction of genetic diversity in agriculture is now underway. The process has been well-documented for food plants, and pertains to vegetables, grains and tree crops. Since 1970, pharmaceutical, petrochemical and other transnational corporations have purchased more than 1,000 once-independent seed companies (Fowler and Mooney 1990; Hobbelink 1991; RAFI 1998, 1999, 2001). Loss of germplasm occurs as transnationals drop all but the most profitable seed varieties from their inventories. For example, the fifth edition of the *Garden Seed Inventory* (Seed Savers Exchange 1999), a list of all commercially available, non-hybrid vegetable varieties in the United States and Canada, shows that sugar beets, broccoli, cabbage, cauliflower, onions and garden peas lost an average of 41 per cent of named varieties between 1981 and 1998. New commercial varieties also appeared during this time, but these were mostly introduced by tiny, independent seed companies, some of them non-profit, and typically represent the commercialisation of pre-existing private varieties, not the result of new breeding efforts.

It is likely that losses of non-commercial varieties maintained by individual farmers, especially in Third World countries, are even greater, as representatives of giant seed corporations reach more and more agricultural areas that have been hitherto isolated from global trade. When this happens, local farmers drop a wealth of existing varieties in favour of the new, commercial, 'high-yielding' seeds. According to H. Sudarshan (Ramprasad 2002), over the last half-century,

> India has probably grown over 30,000 different indigenous varieties or landraces of rice. This situation has, in the last 20 years, changed drastically and it is predicted that in another 20 years, rice diversity will be reduced to 50 varieties, with the top 10 accounting for over three-quarters of the sub-continent's rice acreage.

The impacts of globalisation are being experienced not only by domesticated varieties but by wild relatives of food plants. The wild relatives of cereals, vegetables, fruits, nuts and other crops constitute a critical resource for genes affecting disease resistance, pest resistance, yield, vigour, environmental adaptations, high starch content, soluble solids, vitamins, cytoplasmic male sterility, petaloid male sterility and harvest and transport adaptations. Many of these wild relatives are highly endemic, and their ranges are decreasing sharply because of development, overgrazing, increased herbicide use, logging and conversion of marginal lands to production and export agriculture—all of them related at least in part to globalisation (Prescott-Allen and Prescott-Allen 1983).

As globalisation—both the worldwide spread of technologies and the networking of all economies—progresses, livestock breeds also face an increased risk of extinction. During the twentieth century, according to Hall and Ruane (1993):

> Of the 3831 breeds or breed varieties of ass, water buffalo, cattle, goat, horse, pig, and sheep . . . 618 are estimated to have become extinct . . . . In countries of the Old World, numbers of breeds are correlated with human population and with land area . . . . Peripheral and remote countries have the highest ratios of breeds per million people, implying that remoteness can also promote diversification.

Hall and Ruane demonstrate that in Europe and the former Union of Soviet Socialist Republics (USSR), breed extinctions have generally been highest in those countries, such as Switzerland, that have the highest per capita income. The implications for the biodiversity of domestic animals during globalisation are evident. To this writer, it seems clear that breed diversity in Asia, Africa and the

subcontinent will be reduced by globalisation (as it has in the industrial world), and this reduction is likely to occur long before per capita income increases, if it ever does.

Occasionally, pressures of globalisation can be shown to be causally related to the loss of a particular kind of domestic livestock, as in the case of the near-demise of Haiti's Creole pigs (Aristide 2000). These small, black, long-snouted pigs (not a breed, but what has been called a 'long-term pariah morphotype') (I. Lehr Brisbin, pers.com.), adapted to the Haitian climate and with very low maintenance requirements, were a mainstay of both soil fertility and the rural economy. In 1982 and 1983, most of these pigs were killed as part of a disease control effort required to integrate Haiti into the hemispheric economy. They were replaced with pigs from Iowa (USA), whose needs for clean drinking water, roofed pigpens, and expensive imported feed immediately doomed the project to failure. Haitian peasants, the poorest in the Western hemisphere, lost an estimated US$ 600 million. As President Aristide notes:

> There was a 30% drop in enrollment in rural schools . . . a dramatic decline in the protein consumption in rural Haiti, a devastating decapitalization of the peasant economy and an incalculable negative impact on Haiti's soil and agricultural productivity. The Haitian peasantry has not recovered to this day . . . . For many peasants the extermination of the Creole pigs was their first experience of globalization.

Loss of Wild Species The massive, anthropogenic die-off of plant and animal species now occurring far exceeds the usual extinction rates that have prevailed throughout most of evolutionary history. In 1995, Pimm et al. estimated that extinction rates of taxonomically diverse groups of species from widely different environments were 100–1,000 times their prehuman levels. In 2000, the IUCN's Red List of endangered species showed that 24 per cent of mammals were faced with extinction (Hilton-Taylor 2000), an extraordinary die-off even when compared with that of the late Pleistocene ice ages. During the second half of the twentieth century and beginning of the twenty-first, when global trade and the global expansion of new technologies and exploitation of natural areas have been increasing rapidly, species losses have become comparable to those of the great extinctions of earlier geological epochs.

It is impossible to determine the particular contribution of globalisation to the current extinction rate, or even to separate globalisation from other, interrelated factors such as human population growth. Nevertheless, it is evident that globalisation is making a profound contribution to the great reduction in biodiversity that is now taking place (Ehrenfeld 2002). The negative impact of globalisation on wild species is caused by the following factors: (*i*) increased development and exploitation of populations and natural areas to satisfy new demands of production and trade, including increased logging, land clearing for production agriculture, overfishing of marine fisheries, road-building (Laurance and Fearnside 2002), mining and dam construction (Diamond 2001); (*ii*) secondary effects of pollution from production agriculture (Withgott 2002), fish farming (Edwards 2002; Murray et al. 2002), vehicles burning fossil fuel, added electricity generation, nuclear wastes and other sources; (*iii*) tertiary effects of climatic change from excess carbon dioxide, methane, fluorocarbons and other chemicals; (*iv*) adverse effects of ecotourism on wild flora and fauna (Klein et al. 1995); and (*v*) the impact of the soaring numbers of exotic species, carried by the tremendous plane, ship, rail and truck traffic of global trade, on local flora and fauna (Cronk and Fuller 1995; Murray et al. 2002). Even a trade-related, intensive production system such as aquaculture, which might appear to relieve pressure on wild species, may have the opposite effect (Naylor et al. 2000).

Some of the effects of globalisation on wild species are quite subtle. As Alexander et al. (2002) report, 'Expansion of ecotourism-based industries, changes in land-use practices, and escalating competition for resources have increased contact between free-ranging wildlife and humans.' Although it has long been known that this enhanced wildlife–human contact might be the source of new infectious diseases among humans (including HIV), the reverse situation has received little attention. Alexander et al. (2002) document for the first time the introduction of a primary human pathogen into free-ranging wildlife. They report outbreaks of *Mycobacterium tuberculosis* in banded mongooses (*Mungos mungo*) in Botswana and suricates (*Suricata suricatta*) in South Africa. In both cases, regional increases in human-wildlife contact, especially from expanded ecotourism and other globalisation-related changes in human mobility and land use, appear to be responsible for the disease. Resulting mortality among both mongoose and suricate populations has been heavy.

Environmental Costs of Globalisation

The principal environmental costs of global free trade are well known. They include water, air and soil pollution, exhaustion of non-renewable and slowly renewable resources and global climatic change—all caused by globalisation-related increases in industrial activity, production agriculture and the fossil fuel energy used in the free trade-related transport of raw and finished materials, and by the overriding of local and national protective laws and customs. Regulating the environmental side effects of globalisation is another matter. As Yu et al. (2002) state, 'A country importing "dirty" products essentially "leaks" its pollution to exporting countries that have less strict standards.' Also, 'the conflict between trade and environment arises because countries with weak property rights appear to be more productive even when they are not, and export their natural resources unsustainably'. Article XX of the original General Agreement on Tariffs and Trade (GATT) was intended to safeguard 'exhaustible natural resources' and protect 'human, animal or plant life or health' (Yu et al. 2002), but enforcement of this article by the economists who run the World Trade Organisation (WTO) has been problematic, and is likely to remain so.

Air, water and soil pollution have increased markedly as global trade has increased. For example, in Taiwan, exports have soared as a result of global trade: forests have been cleared for industrial development and tree farms, soil and water have been polluted by pesticides and fertiliser, and 90,000 factories dump their wastes into air and waterways (Bello and Rosenfeld 1990). Goldsmith (1996) notes that, 'The incidence of asthma [in Taiwan] has quadrupled since 1985, and cancer has now become the leading cause of death . . . its incidence having doubled since 1965.'

Yu et al. (2002) suggest that scientists can influence the deliberations of the WTO by providing conclusive scientific evidence of environmental harm. They cite the case of sea turtles which were being caught in shrimp nets: population biologists presented data to the WTO showing that turtle populations were declining drastically as a result of shrimping. But Yu et al. fail to point out that this conclusion was based on a set of turtle-tagging data collected over a forty-year period, a situation nearly unique in population biology. Adverse effects of trade on most other biological resources are likely to be far more difficult to prove, as will the growing effects of chemical pollution caused directly or indirectly by global trade.

A few forms of environmental pollution related to globalisation are indisputable. One is the pollution provided by the transport of raw materials and finished goods that were formerly produced and consumed locally, or done without. The term 'in season', as applied to foods, is no longer comprehended by many First World consumers: sweet peppers and strawberries from Mexico can be purchased in Canadian markets in mid-winter. Even heavy, minimally processed products are transported around the world to places where they already exist in abundant supply. For example, steel shipped from China has replaced American steel in domestic US markets. In many cases, the distant products are cheaper than local ones, because social and economic subsidies render transportation energy costs irrelevant, and because the cost of pollution is not included in the pricing. In the latter instance, as Yu et al. (2002) point out, 'Trade thus globalizes a domestic Tragedy of the Commons'. Therefore, even when the environmental costs of globalisation are indisputable, the market cannot be relied on to control them.

Social Disruption

The social costs of globalisation are numerous and severe. Although a detailed discussion of them is beyond the scope of this article, some of these costs can be listed. They include: (*i*) a widening gap between rich and poor (both individuals and nations)—the richest 20 per cent spend 86 per cent of the world's wealth; (*ii*) the growing power of multinational corporations and the global interlinkage of financial markets, causing regional instability from resource extinctions and rapid geographic shifts of production and financial assets; (*iii*) social unrest leading to greatly increased prison populations (the number of people in jail in the US has gone from less than 200,000 in 1970 to 1.4 million in 2000; sharp increases in prison populations have also been marked in other countries, such as Great Britain and New Zealand, after joining the global free trade economy); (*iv*) the dissolution of families and communities; (*v*) the weakening of democracy where it previously existed; (*vi*) the privatisation and consequent deterioration of health care, education and other social services, especially in the US; (*vii*) the reduction in foreign aid generated by wealthy nations; (*viii*) a sharp increase in the numbers of environmental/economic refugees; (*ix*) an increase in regional wars and international terrorism; (*x*) the loss of many of the world's languages; (*xi*) crippling of feedback and self-criticism (including the elimination of local control over local events); (*xii*) loss of knowledge and essential skills; and (*xiii*) the instability of highly complex and interlinked socio-economic systems (Abramovitz 2001; Ehrenfeld 1993, 1999; Goldsmith 1994; Gray 1998, 2002; Hertz 2001; Mander and Goldsmith 1996; McKnight 1995; Nettle and Romaine 2000; *New Scientist* 2002; Tainter 1988). Globalisation can be seen to be the principal, although not the only, underlying force in all of these adverse changes.

Spiritual Disruption

The Islamic scholar Sayyed Hossein Nasr (1996), author of perhaps the best book on comparative religious attitudes towards nature, has written extensively about the spiritual reasons for and consequences of the global spread of the materialism-driven science and technology that originated in the West. Western religious thinkers, he notes, have been dealing for decades with our spiritual alienation from and destruction of the natural world, the earthly form 'in which the Sacred has manifested itself'. But 'only now is it beginning to dawn upon [the non-Western religions] that the present predicament is primarily the consequence of the loss of a sapiential knowledge of nature and an inner spiritual crisis and not simply the result of bad engineering.'

As Nasr points out: 'Non-Western societies are forced into a global "economic order" within which they have little choice but to follow models of so-called development that are formulated in the West and in which non-Western religions and philosophies hardly play a role.' This, of course, is true, but it is not only the non-Western religions whose environmentally wise teachings have been thrust aside by the globalisation bulldozer. The environmental wisdoms of Judaism and Christianity have also suffered, and have been distorted by efforts to make them appear to justify and validate the environmental damage that is taking place (Berry 1979; Ehrenfeld and Bentley 1985).

The Limits to Globalisation

Social and Economic Limiting Factors

Thoughtful critics of globalisation have realised that global free trade promotes the social and economic conditions most likely to undermine and bring to an end

its own existence. The British social historian and economist John Gray (1998) has stated the paradox of globalisation very clearly. Noting that, 'In the United States [the principal exporter of globalisation] free markets have contributed to social breakdown on a scale unknown in any other developed country', Gray continues:

> The central paradox of our time can be stated thus: economic globalization does not strengthen the current regime of global *laissez-faire*. It works to undermine it. There is nothing in today's global market that buffers it against the social strains arising from highly uneven economic development within and between the world's diverse societies. The swift waxing and waning of industries and livelihoods, the sudden shifts of production and capital, the casino of currency speculation—these conditions trigger political counter-movements that challenge the very ground rules of the global free market . . . . Today's regime of global *laissez-faire* will be briefer than even the *belle époque* of 1870–1914, which ended in the trenches of the Great War.

That globalisation has been able to survive at all is only because it has been able to escape paying the true societal (and environmental) costs of its operations. The economist Herman Daly (1996) has written:

> The increased competition resulting from free trade does indeed promote cheaper products—but there are two ways of making products cheaper: by improving real efficiency, or by simply externalizing costs . . . . Within nations there are laws and institutions that prohibit many cost externalizations. Internationally there are few such laws . . . . International competition tends to be standards-lowering (i.e., cost-externalizing), and thereby destroys community life based on those higher standards . . . . Transnational corporations have escaped the national obligations of community by becoming international, and since there is as yet no international community, they have escaped from community obligations altogether. Globalism does not serve world community—it is just individualism writ large.

Not all those who have profited from globalisation have illusions about its permanence. Billionaire George Soros (1995) has written: 'The collapse of the global marketplace would be a traumatic event with unimaginable consequences. Yet I find it easier to imagine than the continuation of the present regime.'

In the largest sense, the impending demise of globalisation can be seen as just one more example of the hubris of replacing a multitude of intricate, long-evolving, sometimes persistent social and economic systems with one overarching structure (Ehrenfeld 1981, 2002). The fact that this structure is based primarily on the organising principle of greed, rather than on socio-economic equity, stability, or, most important, long-term sustainability and survival, only makes matters worse.

Biological and Physical Limiting Factors

With their destabilising impact on the biosphere, excess consumption (primarily in the North) and technology, mobilised and greatly enhanced by globalisation, are putting demands that cannot conceivably be met on ecosystems and resources.

The Canadian ecologist and regional planner William Rees has noted that 7–9 ha of 'productive land and ecosystems [are] required to sustain the consumer lifestyle of the average North American with prevailing technology'. Yet only 2 ha of 'ecologically productive land and water' are available for each person on earth. His conclusion: 'Number of earth-like planets that would be required in the year 2000, with prevailing technology, to support the entire human population sustainably at North American material standards: five' (Rees 1999; see also Wackernagel and Rees 1996).

Of all the categories of resource whose depletion is likely to bring an end to globalisation, the most likely to be limiting in the short term is energy. In 1973, the economist E.F. Schumacher (1999), writing in the second chapter of *Small Is Beautiful*, compared the fuel consumption of the rich and poor nations, and noted that it was 'implausible' given the global reserves of fossil fuel, that the entire world could consume energy at the (then) rate of the industrial nations, even assuming that one-fourth of this energy came from nuclear power. 'It is clear', he said, 'that the "rich" are in the process of stripping the world of its once-for-all endowment of relatively cheap and simple fuels'. This stripping has been markedly augmented by globalisation.

True, technological advances are capable of reducing energy consumption for most applications, sometimes by a factor of three or four, or higher. But the process of testing, accepting, and incorporating new technologies on a global scale is slow; this is especially true in the developed world, where the mass of existing technology in production, housing and transportation creates an inertia that is difficult to overcome. It is also true in the Third World, where cultural barriers to technological change have their own inertia. And there are other factors that make a technological rescue unlikely. Technological development, itself, is highly dependent on both energy and wealth. For example, nuclear power plants take years before they recover the energy investment of oil required to build them.

New technologies always come with their own side effects, which are generally more expensive and difficult to deal with than the side effects of earlier technologies (Schwartz 1971). Nor are efficiency gains necessarily effective in saving resources and reducing pollution. Wackernagel and Rees (1996) write:

> Profitable efficiency gains—and these are the ones that get implemented—contribute to upward-trending expectations of returns to capital and higher investment in efficient firms. This induces the competitive spread of the efficient technologies to other firms and sectors, which may well increase total demand for resources. Ironically then, it is precisely the economic gains from improved technical efficiency that increase the rate of resource throughput.

In addition to increased efficiencies, technological advance brings new forms of energy consumption. For example, the digital age, which is often touted as energy-saving, turns out to be the reverse. According to Huber and Mills (1999), it takes

> about 1 pound of coal to create, package, store and move 2 megabytes of data . . . . Under the PC's hood, demand for horsepower doubles every couple of years. Yes, today's microprocessors are much more efficient than their forerunners at turning electricity into computations. But total demand for digital power is rising far faster than bit efficiencies are.

Thus technology, which has enabled the spread of our current globalisation, is unlikely to free it from its self-imposed limits.

The principal energy resource fueling globalisation is *cheap* petroleum. Without cheap petroleum it is hard to see how globalisation, which is grossly inefficient and wasteful of energy, could survive. As Daly (1996) has noted, 'Transport costs are energy intensive, and if energy is subsidized . . . then so is trade'. Extracting oil as if its supplies were unlimited is a form of subsidy, a way of externalising costs not only to society at large, but to future generations. It has been evident since the 1970s and earlier that supplies of cheap petroleum are declining rapidly, and that neither undiscovered reserves nor new energy technologies are going to be able to replace them (Duncan 2001; Duncan and Youngquist 1999). Apologists for the present system have tried to deny the reality of an energy shortage that is already well underway, but the absurdity of their arguments was made manifest as long ago as 1978 by Albert Bartlett in a classic article published in the *American Journal of Physics*. Bartlett chose as a limiting assumption that the entire volume of the earth is made of petroleum, and that every drop is recoverable. At the then-prevailing growth rate in energy consumption of 7.04 per cent per year, this earth full of oil, Bartlett calculated, would last only 342 years. But the earth is not made entirely of petroleum, and any realistic estimated lifespan of reserves of cheap oil is correspondingly much shorter.

When will petroleum production peak and start to decline? Estimates range from approximately 2004 to 2020 and beyond (Kerr 1998), with a number of leading petroleum geologists favouring the earlier dates (Campbell 1997). In one critical sense, however, energy (especially oil) production has already peaked: global energy production *per capita* (a function of both energy production and population growth) reached its maximum point in 1979, and has been declining ever since at a rate of approximately 0.33 per cent per year (Duncan 2001). The electrical engineer Richard Duncan (2001), a leading authority on energy grids, predicted in his keynote address to the Geological Society of America's Summit 2000 meeting that the future global decline of energy production per capita will occur in two phases. First, energy production per capita between 2000 and 2012 will decline at an annual rate of 0.7 per cent. Duncan forecasts that this will result

in unemployment, breadlines and homelessness, culminating in 'a rash of permanent electrical blackouts—worldwide'. From 2012 to 2030, the rate of decline will increase to 5.44 per cent per year, with consequences that are both unprecedented and unimaginable, but which will, he believes, involve the demise of industrial civilisation. Whether Duncan's bleak prediction will be borne out by events is impossible to say; other less cataclysmic outcomes are conceivable. Nevertheless, one thing is clear: there are more than enough socio-economic and ecological–environmental limiting forces now at play to guarantee that the days of globalisation *as we know it* are strictly numbered.

Conclusion

It is far easier—and more realistic—to predict the disruption and possible demise of globalisation than to devise strategies to cope with the environmental upheavals to come. Presumably, physical environmental changes, including increases in atmospheric carbon dioxide, changes in temperature, melting of permafrost and oxidation of boreal peat deposits, changes in the distribution and abundance of rainfall and storm events, sea level rise and changes in the ozone shield will have to be dealt with primarily on an *ad hoc* basis, to the limited extent possible. Many biological changes, such as introductions of exotic species and extinctions will similarly have effects that are easy to describe but difficult or impossible to counter, especially with the reduced economic resources available.

Nevertheless, opponents of the worst abuses of globalisation have no excuse to abandon their efforts and wait for nature to bring globalisation to bay. In the realm of social and economic life, much work needs to be done to end the evils of the growing disparities of wealth, the exploitation of South by North, community disempowerment, and cultural and moral impoverishment—all of which globalisation fosters. Responsible critics of globalisation must do more to show the connection between globalisation and its dangerous side-effects, and to keep this association in the public eye. Nor is the task entirely negative; we face the challenge of developing workable socio-economic systems that have a strong regional element and are not dependent on centralised, complex technologies—systems that preserve and enhance wealth in a sustainable way. And we must do this before the chaos of resource exhaustion, ecosystem collapse and global climate change makes the job even more difficult—or impossible. International trade in goods and ideas will and should continue, but the only form of globalisation that is acceptable is one that unites nations in meeting global threats and in preserving the environments, life forms and civilisations of this planet.

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