Sustainability and Rapid Geological Change: A Cautionary Note

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Summary

In this paper I examine the application of the sustainability ideal to mining, groundwater abstraction, natural disasters and background geochemistry and human health. So pervasive has the term become that it often seems to be the only worthwhile goal. Yet there is a fundamental contradiction with the reality of nature, that change is the rule, that thriving ecosystems have checks and balances but no equilibria, and that evolution has been a response to changing environmental conditions. None of this is to argue a laissez-faire attitude or to oppose the notion that we must find a better, softer way of living on this planet, a way that does not exceed its carrying capacity. We can and must work to make renewable resources such as water, crops, and wildlife last longer, but when it comes to non-renewable resources there is no possibility of indefinite, continuous usage. Climate changes, soils and coastlines erode, fossil groundwater when abstracted is diminished in volume, and the day a mine is born it begins to die. To argue otherwise is to mislead through false promises.

What is Sustainable?

Though they tend to mean all things to all people, the terms "sustainability" and "sustainable development" have now acquired prime significance in government, industry, and among the general public. The concept forces people to think ahead perhaps as never before. There are now innumerable definitions, and many declarations and statement of principles for sustainable mining, forests, sport, tourism, transportation, landfills and, even for a “sustainable competitive future” (for a collection on-line see http://iisd1.iisd.ca - the International Institute for Sustainable Development). Nevertheless, I believe that the practical application of the idea is in serious conflict with what we know about earth systems and the dynamics of nature.

As used commonly in English, the word “sustain" means to endure, keep going, strengthen, resist change. To this meaning the Brundtland Commission added a second dimension, that of equitability, in the sense of fairness and sharing. Sustainable systems are those that are capable of continuing so as to meet the needs of present and future generations: they also involve freedom, justice, participation and peace. Systems can be lasting without meeting general human needs - there have always been poverty and people whose needs have not been met - but these systems are not sustainable in this double sense. As a recent survey of global conditions puts it, “the continued poverty of the majority of the planet’s inhabitants and excessive consumption by the minority are the two major causes of environmental degradation. The present course is unsustainable and postponing action is longer an option” (Clarke 1999).

On the other hand, try as we may to improve the quality of life and to meet people’s needs, there are certain common rapid changes in the natural environment that make the goal of a sustainable planet difficult and perhaps even impossible. Nature remains dynamic, and we are a long way from being able to predict and avoid its vagaries. This is true on the geological time-scale, but it is also true on the scale of a normal human life, as we are reminded everyday by the media coverage of earthquakes, storms, or floods. Yet, despite our inability to predict what will happen, say five or more generations ahead, we have a pretty clear idea of many environmental trends over the next 50-100 years: it is with these that sustainability must deal.

Discussion about the durability of the environment takes us back to the ancient debate between the Greek philosophers Heraclitus and Parmenides (Godlovitch 1998). Parmenides argued that “things all somehow comprise one and the same ever-lasting structure" and "fixity, order and regularity" is the character of nature. Heraclitus held that all things and the structure they comprise change "unendingly and irreversibly". One can never step twice into the same river, for "all is eternal flux, strife, chaos, confusion, inconstancy". Indeed, as Godlovitch points out “If sustenance were burned into the nature of things, there would be no scientific reason to regard it as a priority since there would be nothing needing doing."

Sustainability and Mining

Ever since the appearance of the Brundtland report, the mining community has been searching for ways to recast itself in the mantle of sustainable development. Critics see mining as "boom, bust and bankruptcy,” which causes environmental damage that “depletes resources and robs future generations while contributing little to lasting social and economic progress" (Cooney 1999). However, under increased pressure from regulatory agencies and NGOs, there is now growing concern within the mining community for improved environmental and even social conditions that address the social dimension of sustainability.

A recent review of the mining industry in the Western Hemisphere (Warhurst 1999) argues that for many companies protection of the environment, of mine workers, and of nearby communities has become nearly as much a concern as putting "rock in the box." Case studies from Chile, Peru, Brazil, Bolivia, and the United States, show that mining firms that are the most efficient in extracting minerals are also better at protecting the environment. This change also reflects some serious re-thinking about their environmental performance by the corporations themselves. Take the example of the OK Tedi copper mine in Papua New Guinea, which has had great problems with disposing of its mining wastes. Having settled a legal case in 1996 for about A$500 million, it appointed a panel of scientists to recommend the best way to handle these wastes. The report concludes that the impacts of mining are so great that none of the options, from dredging the rivers to closing the mine, is adequate. The Economist (August 21, 1999) quotes the chief executive officer of BHP as saying “The easy conclusion to reach, with the benefit of the reports and 20/20 hindsight, is that the mine is not compatible with our environmental values, and the company should never have become involved.”

For World Bank staffer, Richard Ackermann (1998) mining can be compatible with sustainable development, provided that future generations "have as many opportunities as, if not more than, we have had ourselves." Presumably by "we" he refers to people who receive on-going benefits from mining, rather than those whose lands have been degraded, whose communities have closed and whose jobs have been lost. Ackermann identifies as key elements of a sustainable development strategy for mining 1) building human and social capital, especially through partnership rather than ownership 2) assessing both environmental and social conditions, 3) setting aside funds for post-mine rehabilitation, and 4) sound operational practices. The emphasis here is again on social equity, which the mining industry has not historically been very good at providing.

Participants in a 1998 UN meeting put it another way (Otto & Kim, 1998). Non-renewable resources can become sustainable, they said, when they are converted into a "perpetual positive income stream that sustains human, environmental and economic potential". A mine that helps during its lifetime to improve local and regional conditions, though many decades have passed since it ceased operations, would have left a "positive" legacy. Sustainable mining thus involves: access for future generations to minerals they need; use of the proceeds from mining to strengthen economic activities for future generations; reclaiming abandoned mines for future reuse; mitigation of environmental impacts during mining; and recycling of mineral products.

One important way for the mining industry to pursue seriously the equity dimension of sustainability, would be to promote, strengthen and clean up small-scale (artisanal, informal) mining, especially in developing countries. Up to 13 million people worldwide are now engaged in small mining, and they provide the livelihood for another 80-100 million people (ILO 1999). Small mining tends to be "poverty-driven", but it has a tremendous potential for income for unskilled people (including women, peasants and migrant workers), and if properly managed it can make a significant contribution to alleviating poverty. The national value-added per unit output is also comparatively high. But small mining has many disadvantages, including environmental damage and serious social, cultural and health consequences, especially when artisanal miners enter indigenous territories. Yet, despite the accumulated evidence of the way in which the informal sector touches innumerable lives, the mining industry continues to shy away from efforts to strengthen it. The recent establishment of a Consultative Group for Small Mining is a promising development.

There is, of course, no way to prevent communities, and even nations, from eventually running short of key mineral resources. Short or mid-term durability is simply not possible, even with the best will and the best sustainability policies: the day a new mines opens is the day it begins to die. Mined-out deposits cannot directly sustain future generations, no matter how much local economies have been enriched during and immediately after the mining operations. Perhaps the best that can be hoped for - and it is a laudable aim - is to provide the materials to build a future that will not need these materials. Try as responsible mining enterprises may to be better corporate citizens and to do all the right things for present and future generations, sustainability in mining remains an unattainable goal. No matter how fine the social equitability is, in the short or the long run the resources are exhausted or become marginal. It is increasingly held now that fossil fuels will be effectively gone in a century (Warren Hamilton, in Geology Today, July 1999). Sustainable in the sense of lasting they cannot be, so why pretend?

For some in the mining industry, the ultimate goal has gone beyond one of maximising profits towards one of benefitting, or at least not harming present societal needs. In this regard the recent growth in renewable energy is encouraging: from 1990-98 wind use expanded at 22%/yr and solar at 16%/yr. In contrast oil use grew at only 2% and coal not at all (Brown 1999). All this does not mean that mining should be a "sunset" industry: society cannot function without its products. The problem is that sustainability has been adopted as a priority goal for all endeavours, to the point where those human activities that cannot in the long run last are considered to be undesirable.

As to the unsustainable mining (extraction) of groundwater, Postel (1999) claims that the world's farmers have now an annual deficit of some 160 billion cubic m of water, an amount required to produce about 10% of the world's grain. This deficit is attributed largely to overpumping of groundwater, as in the Ogallala aquifer of the central and western USA. There are many ways to reduce water use, to conserve what is there, and to find and develop more, and geoscientists can indeed help here, as de Mulder and Cordani (1999) have pointed out. But meeting sustainability's goal of durability over generations of fossil groundwater is no easier than keeping mining going indefinitely. You cannot sustain a resource if you extract it faster than it is replenished, though you may certainly contribute to equitability by promoting wise use of what is there.

Sustainability and "Natural Poisons"

There is a common and profoundly anthropoblamist view that if only people would leave the biophysical environment alone, nature would be benevolent, providing and stable (Berger 1998). Yet, natural systems are dynamic and not necessarily evolving in a direction benevolent either to humans or to ecosystems. For example,there are places where naturally-toxic soils and groundwater pose a serious health hazard. Elevated and potential toxic concentrations of As, Pb, Zn and Cu, for example, are found in stream sediments and soils in and around mineral deposits. In Norway, where authorities have tried to encourage greater use of groundwater as a cheap, high-quality alternative to surface water, more than 50% of all bedrock wells exceed recommended drinking water limits for one or more health-related parameters, particularly radon and fluoride: these represent natural "contamination"(Banks et al. 1998) In the Tapajós basin of the Amazon, mercury hazardous to health appears to have a natural source in deeply-weathered soils and rocks, which are washed into rivers from gold mining operations (Telmer 1999). In Bangladesh, the health of millions of people who depend on water from tubewells is now being harmed by high natural contents of arsenic in aquifers (Naidu and Skinner in press).

Sustainability and Natural Hazards

The question of whether sustainability in both its senses can ever be achieved, and therefore if it should be our over-riding goal, comes into sharp focus over the question of hazardous changes in natural environments, as in the increase in the areal extent of deserts and drylands. If, as commonly argued, desertification is a human-induced process of land degradation, then reducing human stresses would solve the problem and lead to sustainable (lasting) land areas. Yet, the paleoenvironmental record shows repeated large-scale changes in the areal extent of deserts which took place long before the advent of modern humans (Petit-Maire et al. 1994). It is surely possible in such regions to reduce human stresses that lead to land degradation (including population pressure, poverty, inequitable land ownership and distribution of resources - Smith and Koala 1999), and to increase general sustainability by improving living conditions (equity). But the long-term future of these regions must remain uncertain because of natural changes. Perhaps the best we can hope for is to be able to forecast climatic and other natural factors that drive desertification, so that threatened societies can prepare themselves for migration or for the desert life.

According to the International Red Cross, 1998 was the worst year on record for natural disasters (weather extremes, floods, earthquakes, volcanic eruptions), creating, at least temporarily, more than 25 million refugees. The Worldwatch Institute claims that some 300 million people were driven from their homes by storms and floods alone (Brown et al 1999). Property losses from recent natural hazards in the US have been estimated at a billion dollars a week. On the other hand, the World Disasters Report 1998 points out that 96% of all deaths in natural disasters were in the developing countries: the intersection between nature's violence and societal wealth is clear.

It may be that extreme weather is on the increase, say at the scale of an ENSO cycle, but what is quite evident is that the harmful effects of natural events will increase as long as populations continue to grow and cities in hazardous locations expand. Natural hazards have not changed, people have. Human errors now turn natural crises into disasters, and the global picture is one of decreasing sustainability, in terms of both durability and equitability.

Free market economics may also lead to greatly increased societal vulnerability through, for example, deforestation via forest fires (Brazil, Indonesia) and engineered river courses (Mississippi, Yellow rivers). The influx of private capital driven by the search for profit has made it more difficult for governments to support public works like embankments and flood control. Thus, many countries that are vulnerable to floods, droughts, cyclones and other weather extremes are having to slash preventive health programs, and are unable to renew aging flood protection measures.

Mileti (1999) argues that in the interests of “sustainable hazard mitigation”, decisions about hazard protection should not simply “transfer risk to other segments of society or postpone disasters", as is commonly the case now. Short-term efforts often backfire by "displacing any potential damage to another location or into the future, and by not adequately protecting against potential major catastrophes". Dams and levees built along the Mississippi River have protected farms and communities from floods in normal years and lulled people into believing that the risks of living on floodplains were low or non-existent. When the “500-year flood” of 1993 swamped the river, it washed away many of those levees and communities.

Mileti’s valiant attempt to apply sustainability concerns to natural hazards stresses the need to shift from a reactive to an anticipatory stance, planning for disasters, not waiting for them to happen. This requires an ability to predict and forecast accurately and/or to stop and/or to avoid catastrophes. There has been much progress in forecasting extreme weather events, in watershed management, and in improved warning systems in many areas. But none of this has been of much comfort to the people of NW Turkey, for instance. Obviously, there is an urgent need for better predictive models, for better monitoring and for preventive measures - as far as they are possible. However even the best engineering efforts seem powerless against the bigger forces of nature.

In the short, medium or long run, natural situations and phenomena that are hazardous to life are part of the character of Earth, and while some may be evaded, most cannot be stopped. The best we can do is to prepare to withstand hazardous phenomena or to evade them by moving out of harm’s way. The older thinking that portrays “disasters as exceptional events, calamities unrelated to the normal scheme of things” still appears to hold sway (Varley 1994). Indeed, there is a school of thought that the use of the word “natural” deflects policy makers from the need to accept that human factors turn crises into disasters (ibid.). It may be that people have been lulled into thinking that science and technology can protect society against nature. To the degree that non-human nature is a causative agent of destruction, and that many places cannot be made safe in the short or medium term, the Earth cannot be sustainable.

A Personal Perspective

It can be argued that one of the reasons that people have not taken global warming more seriously - and begun to plan accordingly - is that they are convinced that the problem is wholly anthropogenic, and that it is only a matter of time before we find a way to solve the problem and to reverse the trends. Therefore, it is not really necessary to plan evasive or adaptive actions. Likewise, there is no need to move away from dynamic, eroding coastlines: erosion is caused by poor construction techniques or insufficient barriers, and engineers will in time find a cure to the problem. How sustainable, how durable can a volcanically or seismically active region be? The simple point is that some places are naturally less hazardous to life than others, and that environmental sustainability is not a universal pre-human condition. As Stephen J. Gould puts it, "Nature does not exist for us, had no idea we were coming, and doesn't give a damm about us.... We value such things as peace, continuity, stability, harmony, permanence, constancy, reliability and the like...Where change is contemplated as desirable, we want to be in charge as the unchallenged agencies of change, and the changes themselves which are valued tend to be those meant to reassert the values of continuity and stability....Such values are neither clear nor sanctioned by nature” (1990).

Geoscientists can and should work to improve the living conditions and quality of life of the vast majority of the world's people, who live in dreadful conditions. Equitability can be enhanced, as de Mulder and Cordani (1999) have enumerated, by providing better information about soils, water, non-renewable resources, foundation conditions, and so forth, in the interests of safety of life and property. In my view, geoscientists do a disservice when they go along with the belief that landscapes and places can last indefinitely in their present or some improved state - the durability dimension. The task of reminding planners and the general public of the reality of natural change and its impacts on society will be aided by monitoring landscape change in geological as well as hydrological or biological terms using, for example, the geoindicator concept (Berger 1997). If baseline conditions can be established and trends of change identified, we should have a better chance of attaining a future that is safer and more equitable, if not indefinitely sustainable. There is no point in talking of environmental sustainability, like sustainable mining, if only half the dimension of the goal is being addressed. So why beat ourselves out struggling for sustainability in the sense of lasting? Non-renewable resources are just that, the earth is dynamic, and we have little choice but to accept nature’s changes, harmful or not.

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