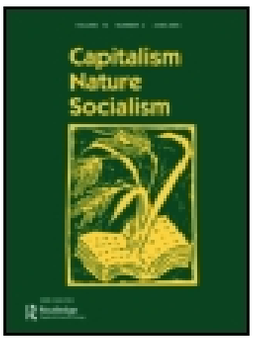

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Joan Martinez-Alier

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REAL ECONOMY

Social Metabolism, Ecological Distribution Conflicts, and Languages of Valuation[1]

Joan Martinez-Alier

The Environmentalism of the Poor in 2008

Thirty-five years after the start of the Chipko movement in 1973, twenty years after the death of Chico Mendes in December 1988 in Brazil as the victim of a "tragedy of enclosures," thirteen years after the death of Ken Saro-Wiwa and his companions for defending the Niger Delta and its populations against the Shell company and the government of Nigeria, the debate on the "environmentalism of the poor" is growing.[2]

The environmental sociologist Riley Dunlap disputes the long-held assumption that the citizens of poor nations will not support efforts to protect the environment, since they are too preoccupied with meeting basic needs such as food and housing. A recent article by Dunlap and York[3] compared results from four large cross-national surveys conducted in several nations with differing levels of average income. Results showed that citizens of poorer nations were equally if not more concerned about the environment than citizens in wealthier countries. Coinciding with the thesis on the "environmentalism of the poor," Dunlap and York argue that Inglehart's explanation of the growth of enviromentalism resulting from a shift to "post-materialist" values fails to recognize that environmental problems are often a threat to material welfare. For example, deforestation may threaten the livelihoods of people who depend on forests for firewood, food sources, and medicinal products.

[1]This paper is adapted from the opening lecture at the Common Ground, Converging Gazes: Integrating the Social and Environmental in History conference, EHESS, Paris, September 11–13. 2008.

[2]In the academic world the debate started late, perhaps with the publication of R. Guha and J. Martinez-Alier, *Varieties of Environmentalism: Essays North and South* (London: Earthscan, 1997) where R. Inglehart's "post-materialist thesis" was roundly criticized. See also, J. Martinez-Alier, *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation* (Cheltenham: Edward Elgar, 2002).

[3]R.E. Dunlap and R. York, "The Globalization of Environmental Concern and the Limits of the Postmaterialist Values Explanation: Evidence from Multinational Surveys," *Sociological Quarterly*, Vol. 49, No. 3, Summer 2008, pp. 529–563.

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Sociologists, political scientists and economists have long ignored ''the environmentalism of the poor,'' as have the two main currents of environmentalism: the ''cult of wilderness'' and the ''gospel of eco-efficiency.'' Adams and Jeanrenaud, writing in the IUCN (International Union for Conservation of Nature) booklet for the World Conservation Congress that took place in Barcelona in October 2008, notice that the ''global environment and conservation movement'' (epitomized by the membership of the IUCN) excludes many organizations dedicated to environmental justice, including those in the U.S. environmental justice movement and many others across the world.

The environmentalism of the poor is represented by organizations like OilWatch, Mines and Communities, the International Rivers Network, the Mangrove Action Project, and the World Forest Movement, which uses the slogan ''Tree Plantations are not Forests.[4] In India, Toxics Link denounces the exports of ships for dismantling in Alang on the coast of Gujarat, as well as the export of electronic waste from rich to poor countries. Via Campesina is a world network of peasant organizations that oppose the imposition of modern agriculture on their communities, because it is less energy-efficient than traditional peasant agriculture, uses more chemical pollutants, and simplifies biodiversity by relying on a very small number of seed varieties and thus placing little value on the many varieties of seeds that have co-evolved over thousands of years through peasant farming. Other organizations demand Climate Justice and the repayment of the so-called ''ecological debt'' from North to South, which includes the ''carbon debt''—i.e., damages from rich countries caused by excessive per capita emissions of carbon dioxide (the main effluent of affluence)—and claims resulting from biopiracy, ecologically unequal exchange, and environmental liabilities by private corporations or northern governments.

These movements combine livelihood, social, economic, and environmental issues with emphasis on issues of extraction and pollution. They set their ''moral economy'' in opposition to the logic of extraction of oil, minerals, wood, or agrofuels at the ''commodity frontiers,'' defending biodiversity and their own livelihood. In many instances they draw on a sense of local identity (indigenous rights and values, such as the sacredness of the land), but they also connect easily with the politics of the Left. However, the traditional Left in southern countries still tends to see environmentalism as a ''luxury of the rich,'' although such movements position themselves in opposition to corporate power and the coercive forces of the state. Indeed, as Bill Adams remarks, these organizations have often been formed explicitly to oppose annexation of land, forests, mineral resources, and water by governments or business corporations.

In the Indian science and environment fortnightly magazine, *Down to Earth*,[5] Sunita Narain gives current examples from that country:

[4]W.M. Adams and S.J. Jeanrenaud, *Transition to Sustainability: Towards a Humane and Diverse World* (Gland, Switzerland: IUCN, 2008), p. 47–48.
[5]Sunita Narain, ''Learn to Walk Lightly,'' *Down to Earth*, August 15, 2008.

> In Sikkim, bowing to local protests, the government has cancelled eleven hydro-electric projects. In Arunachal Pradesh, dam projects are being cleared at breakneck speed and resistance is growing. In Uttarakhand last month, two projects on the Ganga were put on hold and there is growing concern about the rest. In Himachal Pradesh, dams are so controversial that elections were won where candidates said they would not allow these to be built. Many other projects, from thermal power stations to "greenfield" mining, are being resisted. The South Korean giant Posco's iron ore mine, steel plant and port are under fire. The prime minister has promised the South Korean premier the project will go ahead by August. But local people are not listening. They don't want to lose their land and livelihood and do not believe in promises of compensation. In Maharashtra, mango growers are up in arms against the proposed thermal power station in Ratnagiri. In every nook and corner of the country where land is acquired, or water sourced for industry, people are fighting even to death. There are wounds. There is violence. There is also desperation. Like it or not, there are a million mutinies today... After I visited Kalinganagar, where villagers died protesting against Tata's project, I wrote this was not about competition or Naxalism. These were poor villagers who knew they did not have the skills to survive in the modern world. They had seen their neighbors displaced, promised jobs and money that never came. They knew they were poor. But they also knew modern development would make them poorer. It was the same in prosperous Goa, where I found village after village fighting against the powerful mining lobby . . .

The poor, because of their direct reliance on natural resources outside the market, are often careful environmental managers. The environment provides commodities and amenities; it also provides the very conditions of livelihood and existence. In India, there is well-intentioned economic research showing that common property resources contribute a larger amount of money per year than foreign assistance. Actually, economic valuation is irrelevant for assessing the *livelihood values* of water, firewood, soil fertility, and pastures that are essential for adivasi and other poor people who have no money to buy substitutes for them. Part of the income from such projects goes simply to compensate for the loss of free resources that are no longer available because of environmental degradation and population growth, and sometimes because of displacement of poor people by new dams or mining projects.

In an attempt to calculate the economic cost of various environmental assaults on the poor, Gundimedia and Sukhdev came up with "the GDP of the poor."[6] In national income accounts, one could introduce valuations of ecosystem and biodiversity losses either in satellite accounts (physical and monetary) or in adjusted GDP accounts ("green accounts"). But neither method guaranteed an adequate representation. The valuation of losses might be low compared to the economic gains from projects that destroy biodiversity. However, how could one determine which groups of people suffered most by such losses? In the project "Green Accounting for India," the authors

[6]Haripriya Gundimedia and Pavan Sukhdev, "GDP of the Poor – An Illustration for India," International Society for Ecological Economics, 10th Biennial Conference, Nairobi, August 2008.

found that the most significant beneficiaries of forest biodiversity and ecosystem services are the poor, and the predominant impact of a loss or denial of these inputs is on the well-being of the poor. The poverty of the beneficiaries makes these losses more acute as a proportion of their livelihood and incomes than is the case for the people of India at large.

The question certainly arises of who are ''the poor,'' and whether the definition of ''agency'' in such conflicts may rest on such a vague description. In ecological distribution conflicts, the leaders are both women and men, peasants, mine or plantation workers, urban dwellers, indigenous representatives, and civil rights leaders. Women often play a crucial role in such conflicts due to the division of work, power, and access rights to environmental resources according to gender.

What is meant by ''the poor?'' I see two answers. First, in any society we could resort to studies on poverty to classify those who are below a certain poverty line and see whether the main actors in certain types of ecological distribution conflicts belong to such a category. We know, however, that some indigenous groups are not poor; they adapt to their surrounding natural wealth with production systems that are not labor intensive. A second answer is to realize that in some societies, some people see themselves as ''we the poor''—this was obvious in the mid-1960s in rural Andalusia where *nosotros los pobres* was a common phrase with explanatory power for food consumption patterns, migration, and manual labor. As a result of economic growth, social mobility, and immigration, I don't believe this phrase is used in Spain anymore. But it is used elsewhere. In Thailand, opposition to some dams was organized by the aptly named (in English) Assembly of the Poor. In South Africa, Ashwin Desai wrote on social and environmental community struggles after Apartheid, particularly in Durban, with the title ''We are the Poors.''[7]

In their text for the 2008 World Conservation Congress, Adams and Jeanrenaud conclude that to make a transition to sustainability, the environmental movements of the poor must get into the sustainability mainstream beyond their participation in ''community-based conservation'' or co-management of natural parks. An alliance of conservation environmentalism with social justice organizations, feminist groups, and indigenous groups is needed. Both academics and policymakers assumed that residents of poor nations were too preoccupied with satisfying their ''material'' needs to support the ''post-materialist'' values of environmental protection. However, the actual struggles for the environment by poor communities and the historical and contemporary research on ecological distribution conflicts have given much support to the thesis of ''the environmentalism of the poor.'' Sunita Narain explains why the environmentalism of the poor may become a strong force for sustainability:

[7]J. Martinez-Alier, *Laborers and Landowners in Southern Spain* (London: Allen and Unwin, 1971); Ashwin Desai, *We are the Poors: Community Struggles in Post-Apartheid South Africa* (New York: Monthly Review Press, 2002).

> The fact is in India vast numbers depend on the land, the forests and the water they have in their vicinity for their livelihood. They know once these resources are gone or degraded, they have no way ahead. This is the environmental movement of the very poor. Here, there are no quick-fix techno solutions in which the real problems can be fobbed off for later. In this environmentalism, there is only one answer: changing the way we do business, with them and with their environment...If we can listen and learn, maybe this environmentalism of the poor may teach not just us but the entire world how to walk lightly on earth...

Meanwhile, Vedanta is about to destroy the Niyamgiri Hill in Orissa, threatening the local Dongria Kondh people in its search for bauxite.

This does not imply that poor people are always on the side of conservation, which would be patently untrue. What it means is that in many conflicts of resource extraction or pollution, the local poor people (indigenous or not) are often on the side of conservation not so much because they are self-conscious environmentalists but because of their livelihood needs and their cultural values.[8]

Social Metabolism

There is a common ground between social history, economic history and environmental history, between ecological economics and political ecology, between sustainability science and environmental sociology. It lies in the three-tier relation between the increasing social metabolism of human economies pushed by population and economic growth, the resulting ecological distribution conflicts among human groups, and then the different languages of valuation deployed historically and currently by such groups when they reaffirm their rights to use the environmental services and products in dispute.

The economy is described in terms of economic indicators such as GDP growth, savings ratio, and current account balance in the external sector. Economic historians reconstruct the GDP of centuries ago.[9] Social factors are taken into account in demographic and public health statistics, and in the Human Development Index (HDI). The economy may also be described in terms

[8]A definition of "ecological distribution conflicts" was presented by J. Martinez-Alier and M. O'Connor, "Ecological and Economic Distribution Conflicts," in R. Costanza, O. Segura, and J. Martinez-Alier (eds.), *Getting Down to Earth: Practical Applications of Ecological Economics* (Washington, D.C.: Island Press, ISEE, 1996), and J. Martinez-Alier and M. O'Connor, "Distributional Issues: An Overview," chapter 25 in J. van den Bergh (ed.), *Handbook of Environmental and Resource Economics* (Cheltenham: Edward Elgar, 1999). See also J. Martinez-Alier, "The Socio-ecological Embeddedness of Economic Activity: The Emergence of a Transdisciplinary Field," in E. Becker and T. Jahn (eds.), *Sustainability and the Social Sciences* (London: Zed, 1999).

[9]Angus Maddison, *The World Economy: A Millennial Perspective* (Paris: Development Center, OECD, 2001).

of physical indicators. Although economic, social, and physical indicators are non-equivalent descriptions, there is a certain degree of congruence among them.

The economy of a country or a region may be described in the following quantitative terms: it provides, say, 290 gigajoules (GJ) of energy per person per year, its HANPP (human appropriation of net primary production) is 35 percent, and material flow amounts to 16 tons per person per year, of which fossil fuels account for 5 tons. Of the material flows, 6 tons are imported, and 1 ton is exported. Income per capita is US$32,000. It occupies tenth place in the HDI. Of another economy, we say that it provides only 30 GJ person per year, its materials flow amounts to only 5 tons per person per year (mostly biomass), its HANPP is 60 percent (indicating a heavily populated country with little external trade). Foreign trade is less than 0.3 ton per capita per year of exports or imports. Income per capita is only US$2,500 (at PPP), and it is placed 140th in the HDI. Different social classes in such countries have different metabolic profiles.

One basic notion of human ecology is the distinction (due to Lotka) between the endosomatic use of energy (as food) and the exosomatic use of energy as fuel for cooking and heating, and as power for the artefacts and machines produced by human culture. Thus one person per day must eat the equivalent of 1,500, 2,000 or 2,500 kcal. Since one calorie is equal to 4.18 joules, a daily food intake of 2,400 kcal is equal to 10 MJ (megajoules), a convenient round number. If a person is five or ten times richer than the average of her society, she is not for this reason going to consume five or ten times the average food energy. In affluent societies almost nobody starves, and poor people (as in the United States) are fatter on average than rich people, probably the first time this has happened in human history. As regards the exosomatic use of energy, in the course of history, humans have developed numerous artefacts and machines that use energy for production or amusement. While endosomatically the energy consumption of one well-fed person per day is 10 MJ and therefore per year is 3.65 GJ, the exosomatic use of energy varies much more. Poor people use some energy for cooking (more than for eating, if they cook in open fires), to feed small domestic animals, and for making clothes and repairing their house. They might have a pump for the well, if they are better off. If not, they will use human labor to get water, such work being a transformation of the food energy intake. They will also do some travel in overcrowded buses or trains. Altogether, perhaps another 10 GJ of energy per person per year will be used exosomatically. (We are not counting here the warmth provided directly by the sun and indeed the other environmental services such as the rain, the wind, and the carbon cycle, driven by solar energy). Consider now a citizen of a rich suburb, who every day drives 50 kilometers (25 km each way) to work, using at least 3 liters of petrol (30,000 kcal). This energy expenditure is twelve times more than the direct food energy intake of a well-fed person.

In poor countries, food energy is a substantial part of the total use of energy. In other words, the exo/endo energy use ratio is 2 or 3. In the countries of the European Union, the energy use per person per year is of the order of 200 to 300 GJ, and more in the United States where the exo/endo ratio reaches 100.[10] Such elementary facts of economic-environmental history should be part of school education. The unequal exosomatic use of energy largely explains the differences in the per capita production of carbon dioxide, which in turn explains the international conflict over property rights on the carbon sinks (oceans, soils, new vegetation) and the atmosphere as a temporary reservoir, a conflict that could have come into the open when the science of the enhanced greenhouse effect was first established in 1895 by Svante Arrhenius.

Marina Fischer-Kowalski and Helmut Haberl of the IFF in Vienna recently edited a book on socio-ecological transitions,[11] which was heavily influenced by environmental historian Rolf Peter Sieferle and ecological anthropologists, ecological economists, and industrial ecologists. From hunter-gatherer societies to agricultural societies to industrial societies, the authors of this book find quantifiable patterns of use of energy and materials, population densities, land use, and working time. They also try to distinguish possible from impossible futures. For instance, they ask whether it is plausible to think of a world of 9 billion people with an energy expenditure of 300 GJ and a material use of 16 tons per capita per year (the present European average). Or alternatively, are we on the verge of a third socio-ecological transition with new technologies that will reduce energy and material use in the rich economies even if this leads to economic degrowth?

Material and Energy Flow Accounting (MEFA)

Authors working on "industrial metabolism" or in "social metabolism" look at the economy in terms of flows of energy and materials.[12] The economy is a system embedded in the environment, open to the entry of energy and materials, and to the exit of waste.

[10]M. Giampietro, *Multiple-scale Integrated Assessment of Agroecosystems* (Boca Raton, FL: CRC Press, 2003).
[11]M. Fischer-Kowalski and H. Haberl (eds.), *Socioecological Transitions and Global Change: Trajectories of Social Metabolism and Land Use* (Cheltenham: Edward Elgar, 2007). Fischer-Kowalski is a sociologist and the President of the International Society of Industrial Ecology.
[12]R.U. Ayres, "Industrial Metabolism," in J. Ausubel (ed.), *Technology and Environment* (Washington, D.C.: National Academy Press, 1989); M. Fischer-Kowalski, "Society's Metabolism: The Intellectual History of Material Flow Analysis, Part I, 1860-1970," *Journal of Industrial Ecology*, Vol. 2, No. 1, January 1998, pp. 61–78; M. Fischer-Kowalski and W. Huettler, "Society's Metabolism: The Intellectual History of Material Flow Analysis, Part II, 1970-1998," *Journal of Industrial Ecology*, Vol. 2, No. 4, 1998, pp. 107–136; H. Haberl, "The Energetic Metabolism of Societies, Part I: Accounting Concepts," *Journal of Industrial Ecology*, Vol. 5, No. 2, January 2001, pp. 11–33; and H. Haberl, "The Energetic Metabolism of Societies, Part II: Empirical Examples," *Journal of Industrial Ecology*, Vol. 5, No. 2, January 2001, pp. 71–88.

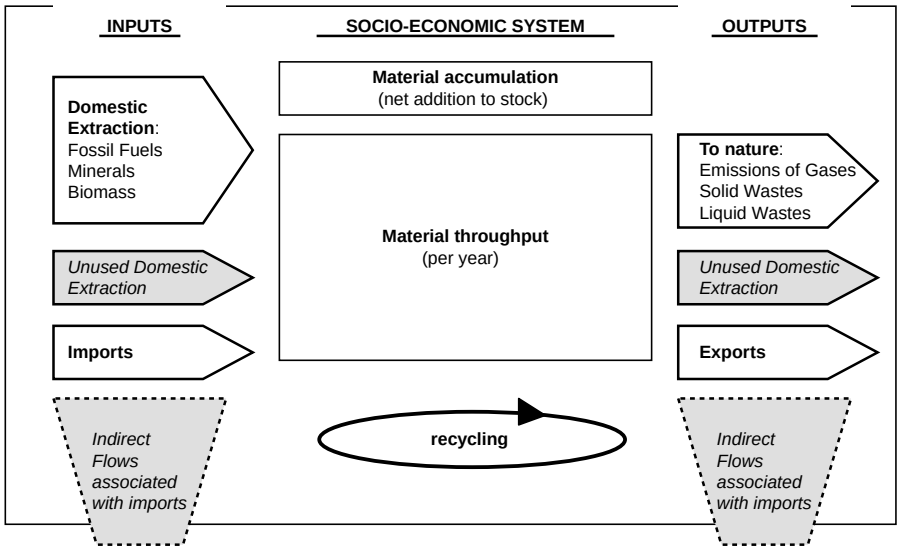

Figure 1. Economy-wide material balances (excluding air and water). Source: Eurostat.

MEFA is a set of methods for describing and analyzing socio-economic metabolism. It examines economies as systems that reproduce themselves not only socially and culturally, but also physically through a continuous exchange of energy and matter with their natural environments and with other socio-economic systems. Eurostat now publishes material flow accounts, and the OECD will publish them soon.[13] The main material flow indicator from the input side is domestic extraction, which covers the annual amount of raw materials (except water and air) extracted to be used as material factor inputs to economic processing. These materials are classified as biomass, construction and industrial minerals, and fossil fuels.

Physical imports and physical exports measure all imported or exported commodities in metric tons. Traded commodities comprise goods at all stages of processing from raw materials to final products. The physical trade balance equals physical imports minus physical exports. Such accounts are relevant for historical and current debates on ecologically unequal exchange and the ecological debt.

Energy flow accounting (EFA) is an integral part of the analysis of social metabolism. Primary and final energy delivered are usually classified in the statistics according to source. The idea of linking economic history to the use of

[13]H. Weisz, F. Krausmann, C. Amann, N. Eisenmenger, K-H. Erb, K. Hubacek, and M. Fischer-Kowalski, "The Physical Economy of the European Union: Cross-country Comparison and Determinants of Material Consumption," *Ecological Economics*, Vol. 58, No. 4, July 1, 2006, pp. 676–698. Also Y. Moriguchi, "Material Flow Indicators to Measure Progress Toward a Sound Material-cycle Society," *Journal of Material Cycles and Waste Management*, Vol. 9, No. 2, 2007, pp. 112–120.

energy goes back to early 20th century Nobel laureate in chemistry, Wilhelm Ostwald, and later to American anthropologist Leslie White and other authors. But it wasn't until the 1980s that several histories of the use of energy in the economy were published. The most interesting EFA indicator is that of Energy Return on Energy Input (EROI), an indicator of energy efficiency that is useful for assessing the increasing costs of obtaining energy. For example, developing agro-fuels or oil sands and heavy oil in Alberta or the Orinoco Delta in Venezuela all have a very low EROI.[14]

The HANPP

Land use fundamentally alters the production ecology of terrestrial ecosystems. Then, harvesting removes net primary production (NPP) from ecosystems so that only a fraction of the actual NPP remains within the ecosystem. The "human appropriation of net primary production," or HANPP, is defined as the ratio between the actual net primary production used by humans and what net primary production would be without human intervention. The HANPP is then calculated in three steps. First, the potential net primary production (NPP, i.e., the production in the natural ecosystems of a given region or country) is calculated. Then, the actual NPP (normally, less than potential NPP because of agricultural simplification and soil sealing) is calculated. The part of actual NPP harvested by humans and associate beings (cattle, etc.) relative to the total potential NPP is the HANPP, an index that is meant to measure loss of biodiversity, because the higher the HANPP, the less biomass available for "wild" species. This assumed relation is itself a topic for research. On a global level,

[14]J. Martinez-Alier, with K. Schlüpmann, *Ecological Economics: Energy, Environment and Society* (Oxford: Blackwell, 1987); R. P. Sieferle, *Der unterirdische Wald. Energiekrise und industrielle Revolution* (Munich: Beck, 1982, English trans., Cambridge: White Horse Press, 2001); C. Hall, R. Cleveland, R., Kaufman, *Energy and Resources Quality: The Ecology of the Economic Process* (New York: Wiley, 1986); J.C. Debeir, J.P. Deléage, and D. Hémery, *Les servitudes de la puissance. Une histoire de l'energie* (Paris: Flammarion, 1986); C. Cleveland, "Biophysical Economics: Historical Perspectives and Current Recent Trends," *Ecological Modelling*, Vol. 38, 1987, pp. 47–73. Charles Hall introduced the computation of the EROI following the work on the energy balance of particular crops, or for small-scale societies, or for the entire agricultural sector of particular countries. R. Rappaport, *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People* (New Haven: Yale University Press, 1967); H.T. Odum, *Environment, Power and Society* (New York: Wiley, 1971); D. Pimentel, et al., "Food Production and the Energy Crisis," *Science*, Vol. 182, No. 4111, November 2, 1973, pp. 443–449; D. and M. Pimentel, *Food, Energy and Society* (London: Arnold, 1979); G. Leach, *Energy and Food Production* (U.K.: IPC Science and Technology Press, Guildford, 1975). One excellent early book is Fred Cottrell, *Energy and Society: The Relation between Energy, Social Change and Economic Development* (New York: McGraw Hill, 1955), while Carlo Cipolla cited the debates on energy and history of the early 20th century in his absurdly anti-Malthusian text, *The Economic History of World Population* (London: Penguin, [1962], 6th ed., 1974). Anthropologists were familiar with these debates through L. White, "Energy and the Evolution of Culture," *American Anthropologist*, Vol. 45, No. 3, 1943 and L. White, "The Energy Theory of Cultural Development," in Morton H. Fried (ed.), *Readings in Anthropology*, Vol. II (New York: Thomas Y. Cromwell, 1959), pp. 139–146. A general survey is found in V. Smil, *General Energetics: Energy in the Biosphere and Civilization* (New York: Wiley, 1991).

HANPP amounts to 20-40 percent of the potential NPP. Global population growth (if it takes place), with its increased demand for wood and agrofuels, will lead to further increases in HANPP.[15]

Unlike material and energy flows, HANPP is not yet an official statistic. Because HANPP is meant to be an index of loss of biodiversity, it is of great interest for the history of wildlife conservation. One can also use it to research conflicts among social groups (pastoralists, agriculturalists, industrial commercial plantations) that have claims on the HANPP in the present and the past. The HANPP has decreased slightly in Europe since the 1950s, but it is growing in many regions of the world, signalling a loss of biodiversity and an increase in social conflicts. Thus, in the struggles for the Net Primary Production of biomass and against the privatization of common property lands, social movements pull out the eucalyptus and other plantation trees and replace them with locally useful trees.[16]

One current research program at the IFF in Vienna tries to construct a database of the HANPP embodied in biomass-derived products. This would be a valuable tool to analyze ''virtual HANPP'' flows associated with trade (just like virtual water flows), thus helping to analyze ecological distribution conflicts.

Virtual Water

Water use should be added to the metabolic profiles in a separate account. There are historical and present conflicts on dams, such as the Narmada Bachao Andolan in India, new conflicts in the North-East, and complaints against the ''interlinking of the rivers.'' There are also conflicts on the use and pollution of aquifers (the Plachimada conflict in Kerala between farmers and the Coca-Cola company is one famous example from the early 2000s). In Brazil there is an organized movement of *atingidos por barragens*. In 2005 a successful civic resistance movement led by Bishop Luiz Carpio stopped water withdrawals from the Sao Francisco River. There are also conflicts on the dumping of waste into water and new debates on the energy and environmental impacts of new desalinization projects.

These issues have led to a new conception, ''virtual water,'' i.e., the water ''cost'' of different products. Beyond the boundaries of the socio-economic system, material flows may be seen as a prerequisite to the materials input of the socio-economic system

[15]H. Haberl, K. H. Erb, F. Krausmann, V. Gaube, A. Bondeau, C. Plutzar, S. Gingrich, W. and M. Fischer-Kowalski, ''Quantifying and Mapping the Human Appropriation of Net Primary Production in the Earth's Terrestrial Ecosystems,'' *Proceedings of the National Academy of Sciences*, Vol. 104, 2007, No. 31, pp. 12942–12947. The first estimates of the HANPP were by Vitousek, et al. in 1986.

[16]J.F. Gerber, ''Conflicts over Tree Plantations: A Preliminary Comparison between a Cameroonian and an Ecuadorian Case Study,'' 10th Biennial Conference, International Society for Ecological Economics, Nairobi, 2008. See also R. Guha and J. Martinez-Alier, *Varieties of Environmentalism*, *op. cit.*, Chapter 1, with a study on claiming the commons in Karnataka against industrial plantations of eucalyptus.

in question, even if these former material flows remain beyond its boundaries. In the Schmidt-Bleek (Wuppertal Institute) tradition, these indirect material flows are termed ''rucksacks.'' One can distinguish between the rucksacks of imports and the rucksacks of domestic materials extraction (another expression used is ''hidden flows''). Water is the most important of the hidden flows. The volume of virtual water ''hidden'' or ''embodied'' (actually, not embodied but evaporated) in a particular product is defined as the volume of water used in the production process of that product. For example, it is estimated that for producing one kilogram of grain grown under rainfed and favorable climatic conditions, we need about one to two cubic meters of water. In principle, a water-scarce country can aim at importing water-intensive products and exporting products or services that require less water (water-extensive products). But in practice, water scarce regions may be exporting virtual water. For example, in Argentina, the soybean frontier has reached the relatively dry region of Chaco. Seen from Europe, this is considered an import of virtual water (as opposed to an import of real water, which is generally too expensive). This relieves pressure on the importer's own water resources and shifts this demand to other countries, triggering eco-social distributional effects.[17]

Early Debates on Social Metabolism and Neo-Malthusianism

Why has it taken so long for an environmental history that analyzes changes in social metabolism to establish itself? In fact, until John McNeill's 2000 book *Something New Under the Sun* systematically analyzed the use of energy and the changes in the main biochemical cycles, environmental history had little ambition to rewrite economic history. Books and articles published in the past on the history of land use, historical geography, agricultural history, climate history, bio-geography, urban pollution, sanitation and health are now coherently classified in the field of environmental history. There were influential attempts to trace the modifications of the face of the Earth by human action.[18] What was lacking was a systems ecology approach quantifying the human impacts in the great biochemical cycles and the changes in material and energy flows. A few technological, environmental and social historians (Joel Tarr, for instance) took this view some decades ago, but other well-known environmental historians still do not look at the economy in terms of energy and material flows.[19]

[17]A.Y. Hoekstra. and P.Q. Hung, ''Globalization of Water Resources: International Virtual Water Flows in Relation to Crop Trade,'' *Global Environmental Change*, Vol. 15, No. 1, 2005, pp. 45–56.

[18]W.L. Thomas, C.O. Sauer, M. Bates and L. Mumford (eds.), *Man's Role in Changing the Face of the Earth* (Chicago: University of Chicago Press, 1956).

[19]J. Radkau, *Nature and Power: A Global History of the Environment* (Cambridge: Cambridge University Press, 2008). This is in contrast to S. Mosley, ''Common Ground: Integrating Social and Environmental History,'' *Journal of Social History*, Vol. 39, No. 3, 2006, pp. 915–933. My own approach is similar to Mosley's. Two excellent though quite different surveys of the field of environmental history are John McNeill, ''Observations on the Nature and Culture of Environmental History, History and Theory,'' Vol. 42, No. 4, 2003, pp. 5–43, whose approach I share, and R. Grove and V. Damodaran, ''Imperialism, Intellectual Networks, and Environmental Change: Origins and Evolution of Global Environmental History 1676-2000,'' *Economic and Political Weekly*, 41 (two parts), 2006.

In fact, there have been proposals to see the economy in terms of energy and material flows since the 1860s. Marx, inspired by Moleschott and Liebig, used the word ''metabolism'' to describe the relations between nature and human society. I would recall here the agricultural energetics of S.A. Podolinsky, which was received negatively by Engels in 1882 and positively by Vernadsky in 1924. Several authors (Felix Auerbach, with his notion of Ektropismus, and also John Joly) had explained life as a process which reversed or slowed down the dissipation of energy. Vernadsky then gave a short biography of S.A. Podolinsky (1850-91) and added a memorable phrase: Podolinsky had studied the energetics of life and tried to apply his findings to the study of the economy.[20] This view of the economy has an intellectual foundation in some 19th century scientists. Economists, however, did not adopt a socio-metabolic view. Are economic historians intellectual servants of the economists? In any case, there was no economic-environmental historiography counting the flows of energy and materials. Only much later, in the 1960s, some natural scientists (again) along with some dissident economists (Nicholas Georgescu-Roegen, Kenneth Boulding, K.W. Kapp, Herman Daly, and Robert Ayres—who is actually a physicist) started to see the economy as a subsystem embedded in a physical system described in terms of flows of materials and energy. Still some years later, in the 1980s, this produced schools of ecological economics and industrial ecology that today look at the economy in terms of social metabolism.

Marx and Engels had a profound interest in the metabolism between the economy and the natural environment, particularly regarding capitalist agriculture. Marx's use of ''metabolism'' became widely known with Alfred Schmidt's work. He noted Moleschott's and Liebig's influences, and also Marx's substantive use of the term in his discussion of the cycling of plant nutrients.[21] However, there has been no school of Marxist economic and social history working on the accounts of material and energy flows.[22]

Marx and Engels were one generation younger than the agricultural chemists (Liebig, 1803-73, Boussingault, 1802-87) who published from 1840 onwards their research on the cycles of plant nutrients (phosphorous, nitrogen, potassium), which was influenced by the debates on the threat of decreasing agricultural yields

[20]V. Vernadsky, *La Géochimie* (Paris: Alcan, 1924), pp. 334–335. I discussed the negative reception of Podolinsky's energy accounts by Engels in J. Martinez-Alier with Klaus Schlüpmann, 1987, *op. cit.*, and more recently in ''Social Metabolism and Environmental Conflicts,'' *Socialist Register*, 43, 2007 and in ''Marxism, Social Metabolism and International Trade,'' in A. Hornborg, J. McNeill, and J. Martinez-Alier (eds.), *Rethinking Environmental History: World-system History and Global Environmental Change* (Lanham, MD: AltaMira Press, 2007), pp. 221–237.

[21]A. Schmidt, *Der Begriff der Natur in der Lehre von Marx*, 3rd ed. (Frankfurt/Cologne: EVA, 1978), pp. 86–89; Martinez-Alier with Shlupmann, 1987, *op. cit.*, pp. 220–226.

[22]I. Susiluoto analyzed the writings on energy and history by Bogdanov and Bukharin in *The Origins and Development of Systems Thinking in the Soviet Union: Political and Philosophical Controversies from Bogdanov and Bukharin to Present-day Reevaluations* (Helsinki: Suomalainen Tiedeakatemia, 1982). This was discussed in Martinez-Alier with Schlüpmann, 1987, *op. cit.*

and the wholesale imports of guano from Peru, an essential bulk commodity. The analyses of the composition of imported guano and other manures and fertilizers (bones, for instance) laid the foundations for agricultural chemistry. Liebig's name was associated by his own wish to a new leading sector of the economy, the fertilizer industry. Liebig may also be seen as one of the founders of ecology before the name itself was invented.[23] Politically he developed an argument against latifundist agriculture and agricultural exports, because the plant nutrients would not return to the soil, and he favored small-scale agriculture and dispersed settlements. Marx quoted this opinion favorably on several occasions. Foster, who rediscovered Marx's "metabolism," analyzed in great depth Marx's debt to Liebig (though not to Moleschott).[24]

Marx found Liebig supremely relevant because he discussed the natural conditions of agricultural fertility and promoted the development of the productive forces by the fertilizer industry. This was useful for the polemics against Malthus. Marx wrote to Engels on February 13, 1866 that Liebig's agricultural chemistry was more important for the discussion on decreasing returns than all the economists put together. Marx dismissed the notion of decreasing returns in agriculture in the context of his praise for Liebig's chemistry and its promise of industrial fertilizers.

Marx was not worried about crises of subsistence. He attacked Malthus not only because Malthus believed in decreasing returns in agriculture but also because Malthus said that improving the situation of the poor was counterproductive since they would have more children. Later, around 1900, there were numerous debates on how many people could be fed. The importance of population growth in the increased social metabolism is obvious, and Paul Ehrlich's equation $I = PAT$[25] could be applied historically if there was an adequate indicator for T (technology). A trend towards a decrease in the world population might appear soon,[26] which should be welcome.

It is likely that the social perception of environmental pressures has an influence on demographic behavior. Work by Francis Ronsin on French neo-Malthusianism by the title *La Grève des Ventres* and by Eduard Masjuan on Spanish, Portuguese, Latin American, and Italian neo-Malthusianism has documented the radical, feminist movement in favor of limiting births that arose beyond Great Britain after 1880. The Neo-Malthusians of 1900 were political radicals (Paul Robin, Emma Goldman). There is then a difference between the

[23]E.J. Kormondy, *Readings in Ecology* (Englewoods Cliffs, NJ: Prentice-Hall, 1965).
[24]John Bellamy Foster, *Marx's Ecology: Materialism and Culture* (New York: Monthly Review Press, 2000).
[25]I = PAT stands for: Human Impact (I) on the environment equals the product of Population (P), Affluence (A: consumption per capita) and Technology (T: environmental impact per unit of consumption).
[26]W. Lutz, W.C. Sanderson, and S. Scherbov, *The End of World Population Growth in the 21st Century: New Challenges for Human Capital Formation and Sustainable Development* (London: Earthscan, 2004).

T.R. Malthus of 1798 and the neo-Malthusianism of 1900. Consider the following definitions:

MALTHUSIANISM: Population undergoes exponential growth unless checked by war and pestilence, or by chastity and late marriages. Food grows less than proportionately to the labor input because of decreasing returns. Hence, subsistence crises.

NEO-MALTHUSIANISM OF 1900: Human populations could regulate their own growth through contraception. Women's freedom was required for this and desirable for its own sake. Poverty was explained by social inequality. "Conscious procreation" was needed to prevent low wages and pressure on natural resources. This was a successful bottom-up movement in Europe and America against states (which wanted more soldiers) and churches.[27]

NEO-MALTHUSIANISM AFTER 1970: A doctrine and practice sponsored by international organizations and some governments. Population growth is seen as a main cause of poverty and environmental degradation. Therefore states must introduce contraceptive methods, even without women's prior consent.

ANTI-MALTHUSIANISM: The view that assumes that human population growth is no major threat to the natural environment and that it is even conducive to economic growth, as Esther Boserup and other economists have argued.

Otto Neurath's *Naturalrechnung* and Max Weber's Misguided Critique of Wilhelm Ostwald

One reason for the difficulty of introducing an environmental history that would account for the changes in the social metabolism of human economies was the resistance in the first half of the 20th century from prominent sociologists and economists, like Max Weber and F.A. von Hayek, against authors who emphasized the importance of the flow of energy in the economy. One such author was Otto Neurath, who in the Socialist Calculation Debate of the 1920s, defended a democratically planned economy based on physical accounting in energy and material terms (*Naturalrechnung*), which was influenced by Popper-Lynkeus' and Ballod-Atlanticus' quantitative, realistic "utopias." Neurath

[27]L. Gordon, Woman's Body, Woman's Right: A Social History of Birth Control in America (New York: Grossman, 1976); *F. Ronsin, La grève des ventres. Propagande néo-malthusienne et baisse de la natalité en France, 19–20 siècles* (Paris: Aubier-Montagne, 1980); E. Masjuan, *La ecología humana y el anarquismo ibérico: el urbanismo "orgánico" o ecológico, el neo-malthusianismo y el naturismo social* (Barcelona: Icaria, 2000). The French neo-Malthusians Gabriel Giroud and Sebastien Faure published books and pamphlets on population and resources. Cf. J. Cohen, *How Many People Can the Earth Support?* (New York: Norton, 1995). At the time the discussion did not take into account the biomass needed for wildlife, i.e., how large the HANPP should be.

introduced the idea of incommensurable values in the economy,[28] which later influenced Karl Polanyi and K.W. Kapp.[29]

Otto Neurath (1882-1945) went on to become a famous logical empiricist philosopher of the Vienna Circle. In the context of the project of the Encyclopedia of Unified Science of the 1930s and 1940s, Neurath defended a dialectical view of history (although he disliked the word "dialectics") as the putting together of the findings of the different sciences regarding concrete processes or events. Neurath saw the writing of history as an "orchestration of the sciences." He advocated that the findings of different sciences collected in the Encyclopedia should not contradict each other, but instead removal of the contradiction should be attempted, an approach well described by Edward Wilson's later word, "consilience."

To grasp the political relevance of Otto Neurath's work, one must understand that Hayek's strong critique of "social engineering" was directed not only against historical thinkers such as Saint-Simon but also (as John O'Neill has put it) against the whole tradition—what is now called ecological economics and quantitative environmental history. This is a tradition that attempts to understand the ways in which economic institutions and relations are embedded within the physical world and have real physical preconditions, and which is consequently critical of economic choices founded upon purely monetary valuation. While Patrick Geddes, Wilhelm Ostwald, Lancelot Hogben, Frederick Soddy, and Lewis Mumford were all rudely dismissed by Hayek[30] because they viewed the economy in socio-metabolic terms, Neurath's *Naturalrechnung* and democratic planning were Hayek's main targets.

One is also reminded of Max Weber's comments against Neurath in *Economy and Society*, and even more of his critique of Wilhelm Ostwald in 1909.[31] Ostwald, a well-known chemist, interpreted human history in terms of the use of energy, influencing Henry Adams (1838-1918). Adams believed there was a "law of acceleration" of the use of (final) energy and noted: "the coal output of the world, speaking roughly, doubled

[28]Martinez-Alier with Schlüpmann, 1987, *op. cit*; J. Martinez-Alier, G. Munda, and J. O'Neill, "Weak Comparability of Values as a Foundation for Ecological Economics," *Ecological Economics*, Vol. 26, No. 3, September 1, 1998, pp. 277-286; J. O'Neill, "Socialist Calculation and Environmental Valuation: Money, Markets and Ecology," *Science and Society*, Special Issue: Building Socialism Theoretically: Alternatives to Capitalism and the Invisible Hand, Vol. 66, No. 1, Spring 2002, pp. 137–151; J. O'Neill, "Ecological Economics and the Politics of Knowledge: The Debate between Hayek and Neurath," *Cambridge Journal of Economics*, Vol. 28, No. 3, 2004, pp. 431–447; T.E. Uebel, "Incommensurability, Ecology and Planning: Neurath in the Socialist Calculation Debate, 1919-1928," *History of Political Economy*, Vol. 37, No. 2, 2005, pp. 309–342.

[29]In a book review in the *American Economic Review*, Vol. 45, No. 4, Sept. 1955, K.W. Kapp complained that "the controversy initiated by O. Neurath, von Mises and Max Weber got sidetracked in various attempts to calculate the prices of productive factors... and O. Lange's later elaboration of a theoretical model of 'competitive socialism.'"

[30]F.A. von Hayek, *The Counter-Revolution of Science* (Glencoe, IL: Free Press, 1952).

[31]M. Weber, "Energetische Kulturtheorien," *Archiv für Sozialwissenschaft und Sozialpolitik*, 29, 1909. Cf. Martinez-Alier with Schlüpmann, 1987, *op. cit.*, Chapter 12.

every ten years between 1840 and 1900, in the form of utilized power, for the ton of coal yielded three or four times as much power in 1900 as in 1840."[32] One hundred years later, research shows the close relation between economic growth and the use of energy in the economy (measured as "physical work output as distinguished from energy [exergy])."[33] Ostwald had proposed two simple laws, which are not untrue, and which might act or not in opposite directions (depending on the strength of what is now called the Jevons' or rebound effect). First, the growth of the economy implied the use of more energy, and the substitution of human energy by other forms of energy. Second, this came together with a trend towards higher efficiency in the transformation of energy inside particular technologies and processes.

Max Weber wrote a famous, ironic review of Ostwald's views, where he insisted on the separation between the sciences and concluded that chemists should not write on the economy. This review was praised by Hayek in *The Counter-Revolution of Science*. Weber's basic point was that economic decisions by entrepreneurs on new technologies or new products were based on costs and prices. It could so happen that a production process was less efficient in energy terms and would nevertheless be adopted because it was cheaper. In Weber's view, energy accounting was irrelevant for the economy, and he did not question energy prices as it is now done when taking into account the enhanced greenhouse effect and the intergenerational allocation of exhaustible resources.

Ecological Distribution Conflicts

The statistics on energy use can be used to explain certain conflicts among humans. For instance, poor people depend upon access to forests to satisfy their need for fuel. There are historical and current conflicts over coal extraction (regarding miners' health, land subsidence, production of sulphur dioxide) and oil extraction (over gas flaring, biodiversity loss). At the global level, more fossil fuel extraction means more carbon dioxide production, which creates a conflict over the distribution of responsibilities and damages from climate change.

Increased use of energy also leads to conflicts regarding transport, such as those created by oil spills. Even wind energy provokes new conflicts in Europe because of the ("post-materialist"?) valuation of landscapes,[34] while other sources of energy give rise to more robust conflicts. Nuclear energy, for example, carries uncertain risks of catastrophic accidents, disposal of nuclear waste, and proliferation of nuclear weapons,

[32]Chapter XXXIV of *The Education of Henry Adams.*

[33]R.U. Ayres and B. Warr, "Accounting for Growth: The Role of Physical Work," in Sergio Ulgiati (ed.), *Advances in Energy Studies* (Padova: SGEditoriali, 2003).

[34]C. Zografos and J. Martinez-Alier, "The Politics of Landscape Value: A Case Study of Wind Energy Conflict in Rural Catalonia," *Environment and Planning A*, accepted in 2008; and G. Gamboa and G. Munda, "The Problem of Wind-park Location: A Social Multi-criteria Evaluation Framework," *Energy Policy*, 35, 2007, pp. 1564–1583.

while agro-fuels are criticized because of their low EROI, because they increase HANPP to the detriment of other species, and because of their "virtual" water content. Such local and global conflicts have different actors with different interests and values. Neoclassical economists attribute "externalities" to so-called "market failure," but from a socio-historic point of view, externalities should be seen as "cost-shifting successes" that are not always accepted quietly.

Similar links exist between increased material flows—which are classified into biomass, minerals for building, minerals for metals, fossil fuels—and social conflicts. There is no current inventory of ecological distribution conflicts in the world, much less a historical inventory. However, clear historical trends appear (including trends in exports and imports) on the material flows, which suggests that they are likely to trigger increasing conflicts. Questions on the absolute and relative "dematerialization" of the economy may be answered empirically.

Such quantitative economic-environmental history is immediately related to conflicts studied by social history. Thus, the trade pattern that concentrates on the export of raw materials has given rise to the notion of ecologically unequal exchange. Such plunder economy was called *Raubwirtschaft* by German and French geographers 100 years ago. At the beginning of European colonization, the goods imported were what Wallerstein called "preciosities." The means of transport at the time made large shipments impossible. Preciosities, which have a high price per kilogram, are of course still traded. They may be integral to the social rituals of some groups, as gold is in India. But consider the disastrous local ecological impacts of exports of ivory or tiger body parts compared to the irrelevance of such trade for the importing countries' metabolism. Sugar was also initially a preciosity. Later, the slave trade enabled it to become a bulk commodity that played a role in the bio-metabolism of the English working class. Other early bulk commodities (such as wood, guano, and cotton) had roles in the techno-metabolism of the importing countries. In the 19th and early 20th centuries, the countries of today's European Union depended on their own coal and biomass as energy sources, but now they are large net importers of oil and gas. Taking all materials together (energy carriers, minerals, metals, and biomass), in 2000 the European Union was importing about four times more tons than it was exporting. Meanwhile, Latin America appears to be exporting six times more tons than it imports. Moreover, Southern exports carry heavier "ecological rucksacks" than the imports, which can be illustrated by comparing the amount of energy dissipated and the carbon dioxide produced by each dollar of exports and imports.[35] Walter Pengue computed

[35]S. Giljum and N. Eisenmenger, "North-South Trade and the Distribution of Environmental Goods and Burdens," *Journal of Environment and Development*, Vol. 13, No. 1, 2004. G. Machado, R. Schaeffer, E. Worrell, "Energy and Carbon Embodied in the International Trade of Brazil: An Input-output Approach," *Ecological Economics*, Vol. 39, No. 3, December 2001, pp. 409–424; R. Muradian, M. O'Connor and J. Martinez-Alier, "Embodied Pollution in Trade: Estimating the "Environmental Load Displacement" of Industrialized Countries," *Ecological Economics*, Vol. 41, No. 1, 2002, pp. 51–67; M.A. Pérez-Rincón, "Colombian International Trade from a Physical Perspective: Towards an Ecological 'Prebisch Thesis,'" *Ecological Economics*, Vol. 59, No. 4, October 15, 2006, pp. 519–529.

the hidden flows in Argentina's soybean trade in the form of loss of nutrients (this would have pleased Liebig and Marx), soil erosion, and the amount of "virtual water" required to produce the soybean crop. Among these hidden costs, Pengue notes the invasive weeds that are resistant to glyphosate, Monsanto's ubiquitous weedkiller, Roundup, which the soybean crop has been genetically altered to resist.[36]

In an ecological-economics theory of unequal exchange, attention is drawn to physical measurements, focusing on the unequal amounts of energy (or exergy, i.e. available energy), materials (in tons), or land used up. Then, the more of the original exergy and materials that have been dissipated in producing the final products or services (in the metropolis), the higher the prices that these final products or services will have to be.[37] Thus, "market prices are the means by which world system centers extract exergy from the peripheries," as Hornborg wrote in 1998.

Not all poor countries are net physical exporters. India and China, for example, are net importers because of their import of oil and other materials. Internally, some regions in India and China provide coal and other minerals, which then become the site of strong conflicts.[38] Meanwhile, some rich countries, like Canada and Australia, with low populations and high material and energy use per capita are net resource exporters, following the path of Harold Innis' "staple theory of growth." Whatever the historically changing positions of different countries or regions, the metabolic processes that maintain the world system centers are guaranteed by ecologically unequal exchange, deteriorating terms of trade for natural resources, cheap labor and cheap human lives in the peripheries, and, when necessary, by military power. When resource exports are produced by transnational corporations, demands for corporate accountability arise, which include compensation claims for damages caused in poor countries.[39]

Some Conflicts on Material Flows and the HANPP

Social and industrial ecologists should become more aware of the implications of their work for the study of social conflicts, while social historians should learn to apply the methods for the study of social metabolism. A case in India related to sand mining (i.e. material flows), and three cases from Africa, India, and Latin America,

[36]Walter A. Pengue, "Transgenic Crops in Argentina: The Ecological and Social Debt," *Bulletin of Science, Technology & Society*, Vol. 25, No. 4, 2005, pp. 314–322.

[37]A. Hornborg, "Toward an Ecological Theory of Unequal Exchange: Articulating World System Theory and Ecological Economics," *Ecological Economics*, Vol. 25, No. 1, 1998, pp. 127–136; J.M. Naredo, "Quantifying Natural Capital: Beyond Monetary Value," in M. Munasinghe and O. Sunkel (eds.), *The Sustainability of Long-term Growth: Socioeconomic and Ecological Perspectives* (Cheltenham: Edward Elgar, 2001).

[38]Leah Temper and J. Martinez-Alier, "Is India too Poor to be Green?," *Economic and Political Weekly*, April 28, 2007, and Sunita Narain's list of conflicts in the fist section of this article.

[39]P. Uttig and J. Clapp (eds.), *Corporate Accountability and Sustainable Development* (Delhi: Oxford University Press, 2008).

which are social conflicts on the access to the HANPP, illustrate the links between social metabolism and conflicts, and the different languages of valuation deployed in such cases.

Fishermen Protected by the Turtles in Kerala

Consider the following conflict on the extraction of sand in northern Kerala, which fell victim to the increased social metabolism of the Indian economy, whose building industry requires sand. While sand in itself is not particularly noxious, its extraction has damaged the coast and rivers in many places in India, resulting in ongoing social conflicts.[40]

In 1992 in Kolavipalam, the *Theeram Pakriti Samrakshana Samiti* (Coastal Ecosystem Protection Committee) was formed after a group of young common fishermen read an article in a national newspaper about threats to the olive ridley turtles (*Lepidochelys olivacea*). After realizing that these were the turtles that nested on their beach and whose eggs were consumed locally, they pooled their own meager resources to pay for some members to keep watch over the beach during the nesting season from October to March. In order to protect the turtle eggs from stray dogs and jackals, they take the eggs from all nests that they find to a fenced hatchery on the beach. The fishermen also realized that mangroves would help control erosion, and they developed a local program to plant mangrove seedlings. The film, *Aaamakaar—The Turtle People* (http://www.turtlepeople.com/), documents their history and efforts.[41] Other media attention on their activities has helped to spread awareness about their project to neighboring coastal villages.

Fishermen are not normally interested in protecting turtles; fishing is a main threat to turtles. The protection of turtles is typically done by conservationist groups motivated by "post-materialist" values. But in northern Kerala, the struggle of poor fishermen to protect their livelihood was successfully combined with efforts to protect turtles, because sand mining is a common enemy to both. So here we see the "cult of wilderness" and the "environmentalism of the poor" become allies. Similarly, conservationist groups sometimes support the struggles of indigenous or peasant communities against the dams or mining projects built to assuage the growing thirst of the economy for more and more energy and materials.

[40]The lucrative practice of sand mining is often done outside the law mainly by sand "mafias" in southern India. Conflicts between environmental authorities and the police are reported in the newspapers. See, for example, "Fatal Accidents Involving Sand-laden Trucks on the Rise: Special squad needs more men to stop illegal sand mining, says Rajesh B. Nair," *The Hindu* (Tamil Nadu), February 26, 2008. Quoting from the story: "Revenue officials said that illegal mining of three metric tonne of sand would fetch a lorry owner around Rs. 3,000. They usually make a total of three trips every day . . ."

[41]Kartik Shanker, "Deconstructing Sea Turtle Conservation in India," in G. Shahabuddin and M. Rangajaran (eds.), *Making Conservation Work: Securing Biodiversity in this New Century* (Delhi: Permanent Black, 2007).

The Chipko Movement: A Struggle on the HANPP using Different Languages of Valuation

Ramachandra Guha is a sociologist who became a social and political historian. His first book was *The Unquiet Woods*.[42] Reading it, I was perplexed by the historical differences between the kingdom of Garhwal under colonial rule and the neighboring district of Kumaun, the role of the king as a Badrinath deity, and also the very different ways of being a Gandhian that the two leaders of Chipko, Sunderlal Bahuguna and Chandi Prasad Bhatt, had. I have travelled in Kausani, in Karanprayag, Rudraprayag, and Deoprayag (the divine confluence of the Bhagirathi and the Alakananda rivers), and I have lectured at the G.B. Pant Institute near Almora. This is part of the territory covered in *The Unquiet Woods*. It is a difficult geography and a beautiful landscape, where you see many uniformed children on the roads going or coming back from school, and down below the green, narrow valleys where rice is grown. Guha mentions the impact of population growth and the migration of men to the plains. I saw many *chir* trees, many lopped *banj* trees, many women carrying home headloads of twigs.

The book goes over the history of a region that developed deep cultural significance several centuries before the Chipko movement. The reader is able to get a clear image of the reasons why peasant resistance in Garhwal to defend access to the forest took the form of ritual petitions to the king backed by demonstrations (the *dhandak*), while in Kumaun there were less structured rebellions and massive arson in the *chir* forests around 1920-21. Guha's book first explains the historical peasant resistance in Garhwal and Kumaun. This history and its protagonists were recollected in the 1970s, when the Chipko movement started. Was this a new environmental movement or another show of peasant resistance, this time with an explicit ecological content that had also existed but remained hidden to analysts on previous occasions?

The book also includes comparisons between peasant resistance in these two regions of Uttarakhand (when they were still part of Uttar Pradesh) and instances of peasant resistance or peasant acquiescence in other countries: enclosure of forests in western Germany (as described by the early Marx), descriptions of peasant or rural laborers' movements by E.P. Thompson and Eric Hobsbawm, work by James Scott in Southeast Asia on the moral economy of the peasants and their everyday forms of resistance, rural novels by Balzac, and analyses of the peasantry by the historians of the *Annales* school in different parts of France. The book also includes comments on the Mexican revolution of 1910 (based on work by Womack and Oscar Lewis), which was about land and water rights, and on the history of peasants' revolts in Java under colonial rule (citing work by Sartono Kartodirdjo). Guha already anticipated his later work on the global history of environmentalism with its emphasis on the "environmentalism of the poor."

[42]R. Guha, *The Unquiet Woods: Ecological Change and Peasant Resistance in the Himalaya* (Delhi: Oxford University Press, 1989).

Guha assumed that there must be similarities in conflicts over forests in different mountain areas around the world. In the central Andes (Bolivia, Peru, Ecuador), the historical struggle was between the agricultural and pastoral haciendas of colonial origin and the indigenous communities, as analyzed by Florencia Mallon and other authors.[43] One could study the ecological contents of such struggles and the fights connected to access to natural resources (pastures, water, dung), all classic ''ecological distribution conflicts.'' Ecological anthropologists pursued the idea (which applies to mountain areas in general) of complementarities in production at different ecological levels, and therefore looked for the institutions (of tribute, barter or markets) that linked together this ''vertical economy.'' There have also been studies (and famous novels) on social conflicts with mining companies. But there was little socio-environmental history in the Andes and indeed in Latin America until twenty years ago. One excellent monograph of Latin American environmental history is by Elinor Melville on the ''Plague of Sheep,'' which documented how a valley near Mexico City in the 16th and 17th centuries turned into a semi-desert, while the indigenous Otomi nearly disappeared. The NPP went down, and it was appropriated by introduced sheep.[44]

Ramachandra Guha is the father of environmental history in India, and he had many followers outside the country. An early one was Nancy Peluso, who in her work on natural resources and peasant resistance in Java showed how scientific forestry in the mid-19th century set up a system that pushed whole villages outside the law. In Spain, the socio-environmental historians González de Molina and Ortega Santos have followed Guha in counting and classifying several kinds of forest crimes in Granada province as a sign of discontent with the disentailment of forests and shrub areas in the 19th century. While in India forests became state property under colonial rule, in Europe there was bourgeois privatization. The explicit common ground with Guha is the illustration of how enclosures lead to overexploitation of natural resources and the elicitation of the ecological content in historical struggles over such resources. In this manner, social and environmental history come together.[45]

[43]F.E. Mallon, *The Defense of Community in Peru's Central Highlands: Peasant Struggle and Capitalist Transition 1860-1940* (Princeton: Princeton University Press, 1983).

[44]E. Melville, *A Plague of Sheep: Environmental Consequences of the Conquest of Mexico* (Cambridge: Cambridge University Press, 1994). For the demographic consequences of the conquest, see A.W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900–1900* (Cambridge: Cambridge University Press, 1986).

[45]N.L. Peluso, *Rich Forests, Poor People: Resource Control and Resistance in Java* (Berkeley: University of California Press, 1992); A. Ortega Santos, *La tragedia de los cerramientos: desarticulación de la comunidad en la provincia de Granada*, preface by M. González de Molina (Alzira, Valencia: Instituto de Historia Social, 2002). There is however a question in environmental history that is unresolved. When did environmental movements become social movements with an ecological content? For instance, consider two early cases of open opposition against the pollution of water and air in copper mining and foundries, one around 1900 led by Tanaka Shozo in Ashio, Japan, against the Furukawa corporation, another one formed by peasants and miners' families in Rio Tinto, Spain in 1888 against the Rio Tinto company. The protagonists of these movements did not use the word ''ecological'' or ''environmental.'' Were these proto-environmental movements?

The forests became state property in India under colonial rule. The main technical advisers were German experts trained in tree plantation economics. Their policy was to maximize the commercial HANPP by growing uniform stands of trees as long as it was economic to do so, comparing the rate of growth of the trees (multiplied by expected price, net of cutting costs) to the rate of interest in the bank. In 1849 Faustmann introduced another factor: the rent one could get from the land for several years (as pastures, for instance) once the trees were cut, while waiting for the next ''crop'' of trees. This additional factor encouraged a shorter rotation. This was the training that German foresters brought to India with its rich tropical and diverse forests. However, the logic of multiple use could not be totally ignored. It was obvious that forests in India were used by the local populations for ''non-timber'' products: they were rich in biodiversity, and they also provided flood control and other ''environmental services'' (to use today's jargon). The debate on the multi-functionality of forests goes back 150 years in India. The institutions of Joint Forest Management since the late 1980s (partly the result of the Chipko movement) and the older institutions of the Van Panchayat in Kumaun, especially after the revolt of 1920-21, have a long intellectual history. In *The Unquiet Woods*, Guha blames German forestry science for imposing the language of forest economics and the logic of *chir* plantations over the peasants' multiple uses of oak forests. In a more recent book he quotes from Dietrich Brandis himself, the Inspector General of Forests between 1864 and 1883, who said that village forests should be preserved and provide poor people with headloads, free firewood; wood for agricultural implements and carts; wood, bamboo and grass for thatching, flooring and fencing; leaves and branches for manure; and grazing, except in areas closed for forest regeneration.[46]

Today, there is data to show that the livelihood of rural poor people in India (and elsewhere) depends to a large extent on non-market goods and services provided by nature, but ''the GDP of the Poor,'' as it has been called, is not easily measured in money. In Garhwal and Kumaun, commercial exploitation of monoculture tree plantations under state ownership prevailed. Demand for wood from the railways (a modest increase in the social metabolism of the economy) was one main factor. But later, in the 1950s and 1960s, demand from other industries such as paper, plywood, and sports goods were added. The Chipko movement was a response to this outside pressure, a response couched in an environmental language. But it was not the first time in the 19th and 20th centuries that the peasants complained.

Guha emphasized the world significance of peasant resistance against economic liberals and Marxists (except for those who followed the Marxian road towards the Russian *narodniki* of 1880). In other works, notably in his outstanding biography of anthropologist Verrier Elwin, Guha analyzed and praised the values of peasants and especially adivasi societies because of their relative freedom from caste and religious constraints, and their sustainable economies. The 20th century witnessed a four-fold multiplication of humans and a doubling of the number of peasants in the world. In

[46]Ramachandra Guha, *How Much Should a Person Consume?* (Delhi: Permanent Black, 2006), pp. 206–207.

this context, we may ask whether the Chipko message of a sustainable rural economy is a relevant worldwide response to the global ecological crisis.

The Tana Delta: Who gets the HANPP? The Threat of Sugar Cane Plantations in 2008[47]

Some land conflicts in Kenya conform to the pattern seen the world over: poor people are confronted by new claims made by agricultural, energy, or mining enterprises. Poor people then reaffirm a prior claim on the land based on legally valid title deeds, their livelihood needs, the sacredness of the land in question, or its ecological values. Such claims also could be expressed by exercising the right of previous consultation against resource extraction, which is recognized by Convention 169 of the International Labor Organization (ILO) for tribal peoples. However, Kenya, like India, has not ratified this convention.

In the Tana Delta near the Somali border, the land is used by Orma pastoralists and Pokomo agriculturalists, while Luo fishermen make use of aquatic resources. The mangroves at the mouth of the river are still intact. No shrimp farming has yet ruined the mangroves as it nearly did in the Rufiji Delta in Tanzania. But there is pressure on the land from the thousands of cattle that the Orma have brought there on a permanent rather than seasonal basis. A couple of miles from the mouth of the river, the mangroves have been cut to leave space for agriculture, and further up, the river banks are deprived of trees. Pastures eroded by cattle reach the river. Crocodiles and hippopotamus still abound in the river and lakes of the Delta, and some Pokomo communities are trying to develop eco-tourism in this beautiful environment.

The old conflict between the pastoralists and agriculturalists is very much alive elsewhere in Kenya, as is the conflict between pastoralists and cattle rustlers. The most famous Kenyan pastoralists are in the highlands, the confederation of tribes called the Masai, with their colorful red clothing. While the Luo (to which Prime Minister Raila Odinga belongs) are a fishing and agricultural tribe of Nilotic origin, the Masai, like the Kikuyu (to which former President, Jomo Kenyatta, and current President, Mwai Kibaki, belonged), came from western Africa from Bantu stock hundreds of years ago. The pastoralist Orma of the Tana Delta arrived much earlier from Ethiopia and Somalia, reaching what is now Kenyan territory perhaps 3,000 years ago. In the Tana Delta, the agriculturalist Pokomo see the Orma as nomad invaders without real roots, although Orma children comprise the majority in many schools, and their elders have built permanent settlements in the area.

[47]I spent the week from July 30 to August 4, 2008 doing interviews in the Tana Delta and in Kwale with Leah Temper and Beatriz Rodriguez-Labajos.

Increasing population pressure on the land and its resources adds to the old enmities. Moreover, new actors now appear. Although Africa is still remembered as a source of ''preciosities'' such as ivory, rhino's horns, gold, precious stones, and as a source of slaves, it is increasingly a source for raw materials essential for the metabolism of the importing countries' economies. One example is oil in Angola, Chad, Nigeria, and Sudan. Another example is uranium mining from Niger for export to France, which has caused a socio-environmental conflict with the Tuareg tribes.[48] Another case is titanium mining from Kwale on the southern coast of Kenya, which has already displaced 400 farming families. Once the operation starts, the ore concentrate exported will equal one big lorry every half-hour for 24 hours each day. When the titanium is exhausted, a big tailings dam will be left behind.

In ancient times the Swahili coast was a center of trade with Arabia and India. As described in the panels of the museum at the Gede ruins, porcelain and other luxury goods had been imported from China since the 8th century. The trade in preciosities continues. Vigorous campaigns were directed against the ivory trade in Kenya in the early 1970s in the last years under Jomo Kenyatta's presidency. The National Museum in Nairobi houses the skeleton of the body of the elephant Ahmed as one of its main exhibits, together with remains of the early hominids in the Rift Valley. Ahmed got police protection around the clock by direct order from Jomo Kenyatta, and he died a natural death with his tusks intact—a victory against poachers.

The export of bulk commodities from South to North, which now includes parts of China and India, is increasing. The Tana Delta might become an exporter of gas, but currently it is threatened by the development of new, enormous industrial sugar cane plantations that belong to both private and state enterprises. The Mumia Sugar Corporation is trying to acquire title to about 20,000 hectares in order to produce sugar for domestic consumption and ethanol to export, burning part of the bagasse, the stalks that remain after the juice is extracted from the sugar cane, to produce and sell electricity. These are mature technologies that are easy to put in place. The cane will have to be irrigated for some months out of the year, and there are concerns about the social and environmental opportunity costs of this water. In the Tana Delta, many of the Pokomo do not oppose the sugar cane plantations, seeing themselves optimistically as potential small-scale growers of cane for the sugar factories. But the pastoralists (and also the fishermen) are adamant in their opposition.

The conservationists of the East African Wildlife Society and other groups dedicated to the preservation of wetlands have taken an active role in the growing conflict of the Tana Delta. On July 11, 2008, they obtained an injunction stopping the sugar cane farming projects. There are technical ecological economics arguments against the projects: the low EROI of sugar cane ethanol when factoring in the energy value of the pastures that would be destroyed, the ''virtual water'' expenditure for

[48]Paper at the 10th Biennial Conference, International. Society for Ecological Economics, Nairobi, 2008, by Aurelie Chamaret, Center 3ED, Université Versailles – Saint Quentin.

growing the sugar cane, and the increased HANPP at the expense of the biomass needs of other species. The judicial case was argued in the High Court of Malindi, a city and tourist resort between Mombassa and the Tana Delta that is famous as the place where Vasco de Gama sailed to India looking for pepper. The conservationists emphasize the values of the environmental services of the wetlands; they want most of the Tana Delta to be designated as a Ramsar site, thus putting it under the protection of this international environmental agreement for the defense of wetlands. At the same time, the conservationists support the Orma pastoralists whose representatives joined them in court against the sugar cane plantations. Here again the global "cult of wilderness" enters again a marriage of convenience with the local "environmentalism of the poor." Some people in Kenya regard the plans for ethanol exports as especially irritating in a country where many people are barely above the hunger line. In our interviews in the Tana Delta, we found that land access and the threat of dispossession by private or state agro-business companies was the major concern.

The Loss of NPP by the Destruction of Mangroves: Cost-benefit Analysis, or the Language of Environmental Justice

Mangroves have been destroyed by urban reclamation and pollution, by lack of fresh water that has been diverted by dams (as in the Indus), by excessive wood cutting for use in building, charcoal making, or tannin for dyes, by cattle grazing, and even by military bombing and herbicide spraying, as for example, in Vietnam.[49] Another main cause of destruction is the itinerant export shrimp industry, which currently occupies large coastal areas of Honduras, Ecuador, Brazil, Thailand, Philippines, Bangladesh, and Vietnam. The NPP declines to zero when shrimp aquaculture displaces mangroves, which provide numerous environmental services, some immediately related to human livelihood.

As for any other investment project (a tree plantation, a mining project, a dam, or historically an *assèchement des marais* or *bonifica*), one could perform an extended cost-benefit analysis. The intention might be to preserve the mangroves or, on the contrary, to help the shrimp industry. If a section of mangrove forest is destroyed for a shrimp pond, what are the benefits and what are the costs?[50] Assuming a shrimp farm produces about 4,000 kg of shrimp per hectare per year selling at a farm price of US$5 per kg, the gross revenue is US$20,000 per hectare per year. This is difficult to match by the (market and non-market) economic values provided by one hectare of mangroves. However, the shrimp pond lasts perhaps only five years, while the mangrove destruction is forever, or at least until a few years after the end of shrimp

[49]M. Vanucci (ed.), *Mangrove Management and Conservation: Present and Future* (Tokyo/New York/Paris: United Nations University Press, 2004).

[50]The accounts below owe much to the study by S. Sathirathai and E. Barbier, "Comparative Returns of Mangroves for Shrimp Farming and Local Direct and Indirect Uses," in Surat Thani Province, in E. Barbier and S. Sathirathai (eds.), *Shrimp Farming and Mangrove Loss in Thailand* (Cheltenham: Edward Elgar, 2003).

farming when the soil becomes alkaline enough to enable replanting. So, we have five years of shrimp revenue compared to, say, fifteen years (five plus ten) of loss of mangrove revenue. A high discount rate on the value of the mangroves will be favorable in principle to shrimp farming.

Certainly, we should deduct the monetary costs of producing the shrimp from the gross revenue. Assuming that labor has other work opportunities, we would therefore deduct labor costs (which are low) as well as the costs of the inputs (e.g., nutrients and antibiotics). Moreover, we would deduct the amortization of the investment costs, approximately US$10,000 per hectare, spread over five years, or US$2,000 per hectare per year. We could then deduct the costs of water pollution using one of two methods: the economic value attributed to the damage produced, or the economic cost of the abatement of pollution down to the desired level. We could also deduct the economic values of other negative externalities (illnesses suffered by women and children collecting seedlings, and costs due to new resistance to antibiotics). Moreover, an obligation could be imposed to replant the mangroves once the farm is abandoned after five years. Assuming this is technically possible, costs may vary considerably, between US$300-$8,000 per hectare, spread out over the five years of operation.[51] Depending then on various assumptions, quantifiable benefits (net of market and non-market costs) could range, at the top, from the equivalent of US$10,000 per hectare per year down to a much lower and even negative figure.

If the mangroves remained instead, what would the per hectare market and non-market revenues be? Here we distinguish between direct and indirect economic values. The direct values are the collected products from the mangroves (shells, crabs, fish, honey, etc.), whether for self-consumption or selling to others, and are only a small part of the production of biomass. A mangrove forest will produce over ten tons of biomass per year, mostly as detritus from fallen leaves. A small part of the biomass (as wood, crabs, etc.) would be collected by humans, who depend on the mangrove forest for their livelihood. Thus, this biomass is essential for their life. However, measured in money terms (and once we factor in the costs of collection at a local wage rate), this biomass in the form of fish, crabs, shellfish, wood, and honey is only worth, say, US$100 or $200 per hectare per year, because the market price of these products is low. In some of these locations, eco-tourism revenues would add greatly to the monetary value of the mangrove forests.

Indirectly, the mangroves provide other current and future (optional) benefits that must be monetarily quantified in order to provide a more accurate picture of their costs and benefits. Such benefits include being a nursery for off-fisheries, providing coastline defense, absorbing carbon from the atmosphere, and acting as

[51]Roy R. Lewis, ''Mangrove Restoration: Costs and Benefits of Successful Ecological Restoration,'' Proceedings of the Mangrove Valuation Workshop, Penang, Malaysia, April 4–8, 2001, Beijer International Institute of Ecological Economics. Stockholm.

a repository of salinity-resistant genetic resources. The methods used to attach monetary value to each of these functions vary greatly and tend to be calculated according to the replacement cost of the benefit in question. Thus, the value of the coastal defense service that mangroves provide can be determined by calculating the cost of building a sea wall. When these costs are included, the money value of mangrove forests easily reaches thousands of dollars per hectare, far exceeding the direct money values of collected biomass. Biodiversity, however, has no ''replacement cost,'' since extinct species cannot be substituted with something else and still maintain the biodiversity of a specific ecosystem. To measure the value of biodiversity, analysts resort to extrapolations from payments in bio-prospection contracts, or to ''willingness-to-pay'' valuations; however, such measures usually give relatively low monetary values. Carbon uptake may be given very different values depending on the concrete CDM case[52] we use for comparison. Typically the loss of the mangroves as a carbon sink will not change the general picture, because the ''price'' assigned to this service is so low—at most $2-3 per ton of carbon. This ''price'' does not reflect in any way the usefulness of the carbon uptake service for humankind and nature but simply depends on the strength of the Kyoto and post-Kyoto commitments. A more realistic reduction commitment would price carbon emissions at US$100 per ton, but this is not the present situation.

Bringing it all together, one could argue that the economic value per hectare per year of the standing mangroves amounts to a few hundred dollars or up to US$10,000 or more.[53] Given that the benefits from shrimp farming accrue in only the first few years, while the benefits from the mangroves could be lost forever, it is easy to conclude that the mangroves may be defended through cost-benefit analysis. Much will depend on the rate of discount, the assumptions behind the figures, and the methods of economic valuation. However, a pro-shrimp economist could easily argue in favor of shrimp farming using a cost-benefit analysis along with a high discount rate on the mangroves, and assigning lower replanting costs and a relatively low value to the coastal defense function.

Another type of comparison between mangrove conservation and shrimp farming development could be carried out using a multi-criteria evaluation, which takes into account a variety of relevant incommensurable dimensions, all expressed in their own quantitative units or qualitative descriptions (economic profitability, employment, biodiversity, coastal defense, carbon uptake, landscape, genetic resources, human livelihood, and local culture, which could include sacredness). The word ''valuation'' does not only mean economic valuation.

[52]CDM, or ''Clean Development Mechanism,'' is one of the three market-based mechanisms that the Kyoto Protocol uses to encourage countries and private industry to reduce their greenhouse gas emissions. For more information, see: http://cdm.unfccc.int/about/index.html.

[53]R. Costanza, et al., ''The Value of the World's Ecosystem Services and Natural Capital,'' *Nature*, Vol. 387, May 15, 1997, pp. 253–260.

Mangroves, being in the tidal zone, are usually public property and belong to the state. In practice, they have been used by local communities according to customary rules and specialized trades (for instance, women shell collectors, male charcoal makers). The required investment for a large commercially viable shrimp farm is approximately US$1 million, which is within the reach of local entrepreneurs. They must either have the local political clout to gain concessions to the mangrove areas or invade them illegally. It's important to see this as an ''enclosure'' movement rather than as an ''open access'' situation. Though resources in open access are too often mismanaged, this does not mean that resources in private property are managed well. The pressure of the interest (or discount) rate encourages entrepreneurs to forget about the future, while the logic of the market leads them to ignore the multi-functionality of the ecosystem. Thus, under private property, we see rapid-growth tree plantations substituted for forests, while mangroves are sacrificed to the monoculture of shrimp farming.

One dawn morning in July 1998, I was a sympathetic observer in an action by Greenpeace and Fundecol (a local grassroots group of about 300 people in Muisne, Ecuador), who destroyed one crop of shrimps from an illegal pond by opening a hole in one of the walls, letting the water flow out, and replanting mangrove seedlings. Below (in my own translation) are the words of a woman from Muisne, Ecuador a few months after the visit by Greenpeace. Her words were distributed to international networks by Fundecol on March 11, 1999. She uses a different language of valuation to that of cost-benefit analysis. She says nothing about the money value of environmental services. Hers is an argument of what in the United States would be called ''environmental justice'' against ''environmental racism'':

> We have always been ready to cope with everything, and now more than ever, but they want to humiliate us because we are black, because we are poor, but one does not choose the race into which one is born, nor does one choose not to have anything to eat, not to be ill. But I am proud of my race and of being *conchera* because it is my race that gives me strength to do battle in defense of what my parents were, and [what] my children will inherit; proud of being *conchera* because I have never stolen anything from anyone, I have never taken anybody's bread from his mouth to fill mine, because I have never crawled on my knees asking anybody for money, and I have always lived standing up. Now we are struggling for something which is ours, our ecosystem, but not because we are professional ecologists but because we must remain alive, because if the mangroves disappear, a whole people disappears, we all disappear, we shall no longer be part of the history of Muisne, we shall ourselves exist no longer... I do not know what will happen to us if the mangroves disappear, we shall eat garbage in the outskirts of the city of Esmeraldas or in Guayaquil, we shall become prostitutes, I do not know what will happen to us if the mangroves disappear... We think, if the *camaroneros* who are not the rightful owners nevertheless now prevent us and the *carboneros* from getting through the lands they have taken, not allowing us to get across the *esteros*, shouting and shooting at us, what will happen next, when the

> government gives them the lands, will they put up big "Private Property" signs, will they even kill us with the blessing of the President?[54]

Conclusion

The metabolism of industrial societies requires increasing amounts of energy and materials, and also increased appropriation of the production of biomass. Hence, new extractions arise at the commodity frontiers. These are often "bulk commodities," though they can also be "preciosities" (gold, diamonds, mahogany, or shrimp). One may study the material flows to test historical trends towards dematerialization or follow the ups and downs of the building industry. One may study the use of energy from the different fossil fuels to see the trend in the world aggregate production of carbon dioxide. One may study the HANPP in a given territory and see whether it really indicates historical trends towards loss of biodiversity. Or one could study the MEFA and HANPP indicators and their links to historical or contemporary environmental conflicts among groups of humans.

Such conflicts are expressed as conflicts over valuation, either inside a single standard of value or across plural values. It might be that an agreement is sought among diverse interests by appealing to the common language of economic valuation, trying to ascertain through extended cost-benefit analysis whether the benefits from a project are large enough to compensate for the losses while maintaining a net gain on top. The requirement for such an exercise is commensurability of values. Social, cultural, economic, and environmental aspects are all measured in money. This is technically difficult to achieve, as we have seen, but not impossible. More importantly, the money-reductionism of cost-benefit analysis harms the social legitimacy of values such as human rights, collective territorial rights, sacredness, ecological, and aesthetic values. Some languages of valuation (livelihood, indigenous rights, sacredness) that were powerful in the past are slowly becoming worthless in this era of the generalized market system where even "the fetishism of fictitious commodities" is in the ascendant in schemes for payment of environmental services, while other languages (human rights, environmental justice against "environmental racism") are gaining in strength.

To conclude, we may say, "shrimp exports [or copper or bauxite mining] is a valuable item of world trade," and also, that "valuable ecosystems and valuable local cultures are destroyed by shrimp farming [or copper or bauxite mining]." The reduction of all goods and services to actual or fictitious commodities, as in

[54]Note that *concheras* are women who collect shellfish, mostly for selling but also for subsistence. *Camaroneros* are the owners of the shrimp farms (*camaron* being the shrimp). *Carboneros* are charcoal makers. *Concheras* get across *esteros* (the swamps) by boat to get to the mangroves and collect the shells at low tide. The coastal population of the province of Esmeraldas in Ecuador (and also across the border in Colombia) is, in its majority, of African descent.

cost-benefit analysis, can be recognized as one perspective among several.[55] Who then has the power to simplify complexity, imposing a particular standard and procedure of valuation? As in other environmental conflicts, political power appears at two levels: first, as the ability to impose a decision, and second, as the power to impose one particular decision-procedure and a standard of valuation. How this power is exercised in different societies in different moments in history is indeed a worthwhile topic of study for sociologists, political scientists, and social historians.[56]

[55]S. Funtowicz and J. Ravetz, "The Worth of a Songbird: Ecological Economics as a Post-normal Science," *Ecological Economics*, Vol. 10, No. 3, August 1994, pp. 197–207.

[56]The present paper is in line with Marco Armiero and Nancy L. Peluso, "Conflict: The Potential Contributions of a Conflict-centered Approach to Blending Social and Environmental History," EHESS, Paris, September 11–13, 2008. A different approach is the study of social adaptations to environmental constraints and changes, and also the study of human impacts on the environment, not focusing so much on social conflicts.