Organization & Environment
23(2) 205–219

DOI: 10.1177/1086026610372134
http://oae.sagepub.com


From Metabolic Rift to Metabolic Value: Reflections on Environmental Sociology and the Alternative Globalization Movement

Ariel Salleh[1]

Abstract

On the assumption that good theory is informed by praxis and vice versa, the essay brings sociological theory together with the alternative globalization movement. The responses of this emerging global civil society to contemporary environmental crises indicate that understandings of labor and value that evolved with industrial capital need to be broadened. The essay opens up this process with an outline of how capitalist production undermines its own social metabolism, a "metabolic rift," that is maintained by the ideological separation of ecology and economics. However, from a grassroots perspective, it is clear that a conceptual vacuum exists between these two disciplines—a space in which a third discourse waits to be articulated. This subliminal "other" sphere of labor and value centers on reproduction of the humanity–nature metabolism by those whose labor is marginalized by capital—unpaid caregivers, peasants, and indigenous gatherers. The terms *meta-industrial labor* and *metabolic value* spell out the material, rift-healing, contribution of this unnamed international class. The essay seeks recognition for a vernacular science, an integrated movement strategy, and more inclusive social theory.

Keywords

metabolic rift, environmental sociology, alternative globalization movement, meta-industrial class, vernacular science, metabolic value, eco-sufficiency

Climate change, biodiversity loss, and social precarity are each results of capitalist overproduction. In responding to this globalizing overshoot, activists need a materialist analysis of social relations, as well as a materialism that engages with ecological processes. The dialectical tools of Marxist sociology already offer a basis for such a synthesis, but it remains a big ask for wider publics, because Eurocentric convention splits economics and ecology apart. This dualist

[1]The University of Sydney, New South Wales, Australia

Corresponding Author:
Ariel Salleh, Department of Political Economy, School of Social and Political Sciences, Faculty of Arts, The University of Sydney, New South Wales, 2006, Australia
Email: ariel.salleh@sydney.edu.au

humanity versus nature ideology does not mark noncapitalist methods of provisioning, however; and so, in a time of crisis it makes sense to see what can be learned from such practices. A first step here is to acknowledge the universality of labor, as that which bridges human intention and the material world. But as the mega-economy brings down the complex of natural systems that sustain life, sociological concepts of labor and value that evolved with industrial capital need to be extended. This will mean rethinking the relation between productive work and reproductive or regenerative work. It certainly will not do, to assume a line of progress from industrial to postindustrial to dematerialized production. Moreover, to build future alternatives with the broadest possible citizen base, a generic notion of labor is essential to ground and integrate worker, women's, peasant, indigenous, and ecological politics. A globally democratic resistance to capital calls for the recognition of "other" labors and the other value that they catalyze. This will mean theorizing nonmonetized activities carried on in the unspoken space between economics and ecology, for it is here that meta-industrial labor anticipates future models of provisioning in a green and autonomous commons.

Metabolic Rift

The process by which peoples take nutrient matter and energy from their environments, digest, and give back in return is called the social metabolism. Throughout history, some modes of production and forms of labor have been more disruptive of these material transfers than others. As John Bellamy Foster (1997, 1999, 2000, p. 158) notes, drawing on Marx, in turn (1976, pp. 637-638; 1991, pp. 949-950), capitalism introduces an especially severe metabolic rift in the thermodynamic reciprocity of humans and habitat. The signs of this rift are deforestation, loss of soil nutrients, poor air quality, water pollution and erosion, toxic wastes, depleted ocean stocks, and so on. Metabolic rift denotes the effect of a specific mode of production, namely industrial capitalism, which destroys the humanity–nature metabolism in an endless pursuit of profits. By the second half of the 20th century, the race for accumulation based on resource extraction, mechanized overproduction of commodities, and World Trade Organization (WTO)–mandated free trade, had spread this rift on a transcontinental scale. The extent of its ecological footprint has even destabilized global climate patterns (Wackernagel & Rees, 1996). According to a Swedish Government report (Johnsson-Latham, 2006), people in the European Union (EU) consume more than the whole of Asia put together. Yet as parts of India and China strive to emulate this "standard of living," it is their greenhouse gas emissions that are targeted for reduction by international political leaders. The established industrial nations, with an ecological footprint spanning 80% of world resources are not reflexive. By their narrative, it is "overpopulation" or "underdevelopment" in the geographic periphery that causes poverty and land degradation. The fact is that most damage in the global South is introduced by offshore export of the capitalist North's own metabolic rift.

There is no denying the irrationality of capitalist economies—mass vaccination for children malnourished by packaged foods, treated sewage drinking water to replace industry wasted aquifers, and carbon sequestration to enable more coal-fired power stations. Capitalist-designed environmental remedies continue to intensify the metabolic rift. Within the sociology profession, ecological modernists like Arthur Mol and David Sonnenfeld (2000) see technological improvement as a way out of the crisis—productive efficiency the goal. On the other hand, Richard York and Eugene Rosa (2003), in a comprehensive review of studies on the relation between industrial growth and sustainability, uncover little empirical evidence of entrepreneurial commitment or regulative zeal for change. They find that neither business initiatives nor state-driven environmental management of industry significantly alleviate the impacts of growth oriented production. A study by Allan Schnaiberg, Pellow, and Weinberg (2002) even reveals proponents of

eco-management basing their optimistic conclusions on selectively sampled research findings, and much of this, methodologically flawed. Institutional solutions for ecosystem protection cannot be relied on in a capitalist society (Salleh, 2006).

York and Rosa (2003) go on to observe that ecological modernists tend to overlook equilibrium effects, as one economic sector surges ahead with new efficiency devices and another declines. Modernists are also prone to misleading single variable assessments of progress, as one polluter like coal, is replaced by another like nuclear power with its multiple attendant risks. By choice of methodology, the organizational focus of ecological modernization studies often misses subtleties at the micro or behavioral level. Similar criticisms apply to the natural capital approach of Paul Hawken, Amory Lovins, and L. Hunter Lovins (1999), whose claims to dematerialized production are often unsubstantiated. Small capitalized improvements in efficiency may actually lead to more production, and thus more energy use, as Schnaiberg et al.'s classic treadmill of production analysis illustrates. Often, an illusion of dematerialization results because resources drawn from overseas are not factored in (Clark & York, 2005). The transport associated with global trade in raw commodities and manufactures may give rise to externalized economic and ecological costs, through ocean oil spillages; trans-continental movement of disease organisms; and greenhouse gas induced climate disturbance. Far from the expected trickle down from educated affluence to green awareness, modern wealthy states are consistently the worst polluters, which fact puts the lie on ideas of "development," by the North, for the South. In the holistic reckoning of Commoner's (1971) "no free lunch" thesis, of Illich's (1977) technological threshold, or the powerful Marxian concept of metabolic rift, dematerialization is as often as not supermaterialization; wherein costs are simply rendered invisible by spatial or temporal displacement on to others. This may constitute an ecological debt to peasants and indigenes in the geographic periphery as their conditions of livelihood are taken away; or, an embodied debt passed on to women in the "domestic periphery," the bearers of intergenerational costs.

In this top-down geopolitical context, the reverse proposition that mothers or small farmers might be skilled ecological and economic managers is likely to be difficult to get across. Sociologists of metabolic rift (Burkett, 1997; Clausen & Clark, 2005; Foster, 2000) and ecological economists like Joan Martinez-Alier (2002) are promoting an awareness of the metabolism by which humans are embedded in biological systems. Most of this research is sensitive to agrarian societies. In related vein, the world-systems agenda of Hornborg, McNeill, and Martinez-Alier (2007) treats metabolism on a macro scale, addressing monocultural land use, markets and material flows, core/periphery distribution conflicts, and externalization. However, this work risks reifying systemic processes by ignoring significant cultural differences and the thoroughly sex-gendered character of capitalist productivism. Why is it, for example, that most women across the world are socially positioned as labor right at the base of the accumulation hierarchy? In every society, women have been accorded the meta-industrial labor of mediating the humanity–nature interface. Indigenous work and subsistence farming are also meta-industrial processes (Salleh, 2004, 2009). It is customary to refer to these diverse marginal workers as victims of capitalism. But it is surely time for sociologists to acknowledge the very specific form of value that is catalyzed by their labors. Indeed, the experience of reproducing nature's metabolic cycles gives rise to a characteristic epistemology and practice, one that can be articulated as a people's science.

Naming the Class

There are two levels of challenge in this call—intellectual and existential. The first pertains to theory: as academics build new conceptual tools that are grounded and inclusive. The second pertains to praxis: as political activists build mutual recognition within the global "movement of movements" (Mertes, 2004; Smith et al., 2007). Ideally, any such division between theory and praxis

will become a complementarity, but the immediate focus of this essay is a theoretical pitch. How to synthesize the perspectives of a sociologically mixed class of workers, mothers, peasants, and gatherers? And how to encourage their self-conscious move from *en soi* to *pour soi*? Many Marxist thinkers, whose object is the mode of production, have had a hard time accounting for reproductive labor. Meanwhile, post-Marxists like Michael Hardt and Antonio Negri (2004) assert that the theoretical distinction between production and reproduction is made obsolete by the 20th century information technology revolution and rise of immaterial labor. Again, in their view, the application of science to agriculture turns the peasant class into a remnant of history. The existence of a burgeoning worldwide Solidarity Economy (2009) movement and thriving international organizations such as Via Campesina (2007) contradicts this. So too, these small farmers point out to the environmental movement that their reproductive mode of production actually "cools down the earth." At the same time, Indigenous Peoples are alerting the world to their skills in biodiversity and catchment preservation (Mujeres Manifesto, 2009; Planet Diversity, 2008). In the wake of the failed 2009 Copenhagen Climate Summit, these claims arrive at the political cutting edge as President Evo Morales sets up a People's World Conference on Climate in Cochabamba, to be hosted by indigenous peoples and the women of Bolivia (Morales, 2010). For Morales knows well that beyond the logic of commodification and circuits of exchange value, another model of social metabolism exists in the labor of peasants, indigenous peoples, and houseworkers. It might be argued that their provisioning absorbs production into a mode of reproduction. In any event, the nonmonetized but regenerative activities of this unnamed class are not only essential to sustaining everyday life; in many so-called developing regions, this labor materially resources capitalist markets as well.

A theorization of other labor forms began in the 1970s when feminists on the Left pointed to a blind spot in the prevalent assumption that all economic value arose from the labor of commodity production. Later scholarship by Paul Burkett (1997, 1999) would show how this popular movement reading of labor and value oversimplified the Marxian dialectic. If Marx gave most of his attention to the human condition, he also acknowledged nature's part in the generation of value. Moreover, workers themselves in this dialectic were seen as "forces of nature" pitted against nature by the capitalist production process. When Marx wrote in this way, he was contesting the ideology that alienated humans from nature. The trouble is that it is difficult for many women to accept their labor as "a force of nature," because their particular alienation from nature under capitalism is a double one. In addition to the general alienation experienced by the working man, women have been oppressed by being treated ideologically as part of nature; by having less than fully human status, a second class position as animal, childlike, dirty, "closer to nature." And materially, women's work has involved the mediation of nature on behalf of men. The 20th-century advent of reliable contraception and principles of equal pay eased this patriarchal discrimination to a degree, but it remains a structural feature of the capitalist economy. The upshot has been that feminists tend to have an aversion to being associated with nature; it places them in a political double bind that is not experienced by men.[1]

Struggling to break this double bind, feminists argued that the work of wives and mothers in bodily and socially reproducing labor power also contributes to the creation of economic value. In the 1970s, this standpoint of the wages for housework group and others became known internationally as the domestic labor debate (Dalla Costa & James, 1972). And there followed an extensive literature on the multiple contributions of women's reproductive labor to the maintenance of capital (Gibson-Graham, Resnick, & Wolff, 2000; Sargent, 1981; Waring, 1988). Meanwhile, Vandana Shiva (1989) made visible the role of peasant reproductive labor in the maintenance of natural environments, and ecological feminists have continued to draw parallels between housework in industrialized societies and subsistence activities in postcolonial contexts (Bennholdt-Thomsen, Faraclas, & von Werlhof, 2001; Mies, 1986). Others tease out the often paradoxical

implications of these insights for deep ecology, eco-socialism, and theories of political ecology at large (Salleh, 1984, 1997, Salleh & Hanson, 1999). Suffice it to say, any theorization of labor based exclusively on the experience of working men, is seriously deficient.

Writing not as an eco-feminist, but in the context of world-systems theory, Steven Bunker (2007) draws a nice contrast between reproductive provisioning and the extractive industrial economy:

> The long-term maintenance of human life depends on energy transformation processes of which we are not yet aware . . . Extraction and production originally occurred together in social formations bounded by a single regional eco-system. In such conditions, human needs usually distributed extractive activity across a wide range of species and minerals; relatively little matter and energy were extracted from each of a large number of forms, so biotic chains could re-produce themselves stably . . . [By contrast] Industrial modes of production . . . inevitably undermine the resource bases on which they depend. (p. 251, pp. 254-255)

Bunker's description resonates with the metabolic rift thesis, but the implicit suggestion that local economies are a thing of the past will be shared neither by majorities in the global South nor by young advocates of the commons. For instance, in 2009, the European Coordination of Via Campesina arranged a learning encampment near Minerve in France, directed at

> . . . people who wish to settle in agriculture, who are young peasants, landless peasants and/or want to recover food sovereignty . . . [and to struggle] . . . for access to land, for fair agricultural prices, for the social recognition of farmers, against the domination of the industrial farming model and for fair agricultural policies. (Via Campesina–European Coordination, 2009)

Alongside this meta-industrial approach to green jobs, Bunker also speaks of a new non-extractive mode of production, but details are scarce and caution is due.

For the route out of environmental collapse takes many false turnings—from the hyper-efficient machine of ecological modernization to the postmodern rhetoric of nature as "socially produced." Each serves to legitimate ongoing capital accumulation, on the one hand, and ongoing dissolution of biotic relations, on the other (Wallis, 2008). Consider the corporate push into nanotech and the Knowledge-Based Bio-Economy (KBBE) sponsored by the European Commission (Europa, 2007). Of course, a true bio-economy will only be found at the peripheries of capitalism, but that is not appreciated where the faith in technology rules. This is why it is curious to encounter Michael Hardt, theorist of the information society, expressing a sense of something "other out there," something waiting to be named:

> . . . proposals that rely on the capitalist measurement of value and the market rationality that presumably accompanies it, cannot grasp *the value of the common* and address the problem of climate change at the fundamental level, even through such indirect means. Forms of life are not measurable or, perhaps, they obey *a radically different scale based on the value of life*, which it seems to me we have not yet invented (or perhaps we have lost). (Hardt, 2009; italics added)

The present essay is a first step in the search for that "radically different scale based on the value of life," and it begins by juxtaposing the ideal typical features of the standard ecological discourse, on the one hand, with the dominant economic discourse, on the other.

Metabolic Value

Among its several meanings, the Greek prefix *meta* carries the idea of change and innovation. The word metabolism denotes a complex of natural processes by which transformations of matter and energy nourish ecosystems and bodies.

Ecological discourse	"Nature—thermodynamic sector"
Agents	Matter/energy transfers via plants, animals
Logic	Relational, cyclic, flow oriented, regenerative
Benefit	Metabolic value, organic reproduction
Cost	nil

The language of ecology conveys nature as a thermodynamic web, activated by organic and inorganic agents, not least animal and plant bodies ensuring sustenance. It would be anthropocentrism to attribute intentionality to nonhuman forms, but material principles of existence can be gleaned by attending to how ecosystems hold together through reciprocal transfers across biotic linkages. An ecosystem spontaneously creates metabolic value and this intrinsic capacity for organic reproduction protects it against entropy. This value appears to be relational, immanent, and emergent in the material and energetic integrity of living processes—in nature and in human bodies as nature. It is the opposite of the disorganization and metabolic rift wrought by extractive and reductive production techniques. The entropy of rift means that flows of matter and energy no longer circulate coherently, building up and breaking down organic and inorganic forms. Human attempts to redesign nature, by say, dam construction or nanotechnology, invariably risk entropic disintegration.

The mainstream discourse of economics functions to justify the metabolic rift between humanity and nature, as if this rift were an ontological constant. But the rift is an historical artifact of factory capitalism and its high-tech successors.

Economic discourse	"Man—the productive sector"
Agents	Entrepreneurs, wage labor
Logic	Reductionist, linear, stock oriented
Benefit	Exchange and use value—satisfaction for a few
Cost = entropy × 3	
Social debt	Exploitation of worker's surplus
Embodied debt	Exhaustion of reproductive labor
Ecological debt	Degradation of natural metabolism

Entrepreneurs and workers are the nominal drivers of productivity in this discourse, which has both capitalist (and occasional) socialist versions. Yet as extraction expands horizontally across the globe and vertically into human body cells, material subsumption is matched by an ideological subsumption—the repressive tolerance of "sustainable development" by which means the World Bank, international agencies, and tame academics, ease the way for ever more capitalist appropriation. For instance, African subsistence farmers—largely women known as "the continent's breadbasket," are right now being subjected to a new "green revolution" by an army of governments, UN agencies, corporate foundations, and university research centers. The plan is for African governments to warm the flanks of private investors in the global North by dedicating 10% of annual national budgets to this green revolution, in order to achieve a 6% annual growth in agricultural productivity (NEPAD, 2009).[2] This cash injection for previously autonomous economic producers, will destabilize traditional mores, time-tested cultivation practices, and people's land

tenure. An absorption of eco-sufficient communities into the international economy, this scientific "enclosure movement" should be resisted on both environmental and justice grounds.

While the capitalist mode of production generates profit for a few by displacing the costs of production on to the many—these externalities become depletions of both laboring bodies and nature's capacity for self-renewal. Thus, there is a social debt born by exploited workers, an embodied debt taken out on reproductive labor in the home, and an ecological debt to entropic nature (Salleh, 2009). The word debt is used metaphorically here, to convey an unequal exchange, a nonreciprocal material transfer. These complex losses may be incommensurable but are readily perceived as qualitative changes in environmental or human health. Today, international activists who recognize the moral force of social and ecological debt demand monetary reparations for peoples in the global South (Quito Statement, 2007). However, in the submissions of South American governments to the Intergovernmental Panel on Climate Change (Third World Network, 2009), the expectation that money spent on new technologies can actually mitigate global warming is a lapse into the reductionism of capitalist reasoning. Just as metabolic rift cannot be restored by mechanical means, so metabolic value cannot be purchased. A sounder way to avoid exploitation and entropy is to delink from the global North and its programs (Bello, 2002). Ecological and social debt is best resolved by people holding on to or gaining access to land for eco-sufficient provisioning. As for embodied debt, the thermodynamic draw down from regenerative workers—most often women, is still not taken seriously either by scholars or by the alternative globalization movement.

In spite of their good intentions, many activists who reject the capitalist mode of production—socialist, feminist, environmentalist—may still be compromised by their material dependence on it. Then again, academic knowledge making is deeply embedded in the capitalist reward structure. In fact, its procedures often mirror the commodity form, and rely on its labor hierarchy. Consultancy responses to ecological breakdown can be one-dimensional, as in the case of carbon trading; or masculinist, when the reduction of domestic carbon emissions is presented as a policy issue "for women." Another limitation affecting sociological analysis is the narrowly anthropocentric use and exchange value pair. The material bottom line of any economy is a flourishing ecosystem and this can only be represented by metabolic value. To repeat: An ecosystem spontaneously creates metabolic value and this intrinsic capacity for organic re-production protects it against entropy. This value appears to be relational, immanent, and emergent in the material and energetic integrity of living processes—in nature and in human bodies as nature.

Meta-Industrial Labor

The Eurocentric dissociation of humans from nature is an old cultural contradiction, often called on to justify the capitalist domination of class, race, sex-gender, and species others. It would be more accurate to say that people themselves are ecosystems, in humanly embodied form. Meanwhile, caregivers, peasants, and foragers, are the indispensable intermediaries of ecosystemic flows and human aspirations—a gestation that is received globally in denial, a "symptomatic silence" to re-coin an old 1970s phrase. The material embodiment of humans means that ecological discourse and the sphere of regenerative activities share an overlapping terrain, but given the conceptual vacuum that exists between ecology and economics, there have been not been words to articulate this sphere as an alternative mode of production.

Subliminal discourse	"Woman/Native—reproductive sector"
Agents	Meta-industrial—carers, peasants, indigenes
Logic	Relational, cyclic, flow oriented, regenerative
Benefit	Use value and metabolic value, bio-complexity
Cost	Nil

The term meta-industrial labor denotes workers, nominally outside of capitalism, whose labor catalyzes metabolic transformations—be they peasants, gatherers, or parents. The term *metabolic value* denotes the value sustained and enhanced by this kind of worker in supporting ecological integrity and the social metabolism. Meta-industrial workers translate principles learned hands-on in the material world—a vernacular epistemology, cognizant of cross cutting synergies in living processes, and replicating these thermodynamic circuits of nature. This labor is relational, flow oriented, and regenerative of biotic chains. Its unique rationality is a capacity for economic provisioning in a way that preserves metabolic value as it goes. Unlike the extractive mode of production with its inevitable metabolic rift, this economy is eco-sufficient without externalized costs in social, ecological, or embodied debt. Where the global North has not yet appropriated local resources by means of aid projects or climate tradeoffs like the Clean Development Mechanism (Isla, 2009), the labor of indigenous cultivators in the global South has established a good "metabolic fit" between human growth and ecological growth. In using the word "fit," I am inspired by Jessie Wirrpa, an Australian Aboriginal elder and mentor of anthropologist Deborah Rose (2008).

In the global North, the usual site of meta-industrial labor is the nonmonetized domestic sphere. Even so, many houseworkers, targeted by advertising, succumb to false needs and reliance on market commodities and services. When household functions are mechanized, meta-industrial labor is less visible, but it does not go away. It is simply incapacitated, as people lose the knowledge of how to keep food fresh without a refrigerator or how to wash clothes without an electrified whirlpool. Of course, men in the domestic periphery are equally capable of undertaking regenerative forms of labor and expressing the life-affirming values learned from doing them. But as women enter the paid workforce, few men reciprocate the structural shift by taking the domestic option. Rather, the care work of attending to embodied cycles is displaced down the accumulation hierarchy on to migrant remittance workers from the geographic periphery (Federici, 1999; Rosewarne, 2004).

When people control their social metabolism bioregionally, providing use values such as food and shelter for their community, the subliminal (sociologically unspoken) site of meta-industrial labor constitutes an autonomous economy. However, increasingly, local subsistence, the maintenance of forest stands and water catchments by customary labor, is captured by "development aid" and made to subsidize the capitalist mode of production. The geopolitical metabolism expropriates resources of every kind, not least among them the industrial vagina cheaply supplied to men of the global North by women of the South. Likewise, North and South, the domestic periphery supplies metabolic value to capital through intergenerational nurture of the bodies of wage workers. This nonmonetized labor is often called "pre-industrial" by sociologists, liberal economists, and socialists who see manufacture as the norm. But meta-industrial labor exists concurrently with capitalism and even so called dematerialized production cannot do without it. International support for meta-industrial workers could promote their culturally embedded, autonomous provisioning skills, and their rights to continued sovereignty of livelihood. Instead, programs for "sustainable development" or "greenhouse development rights" make top-down managerial interventions, advancing the logic of commodification rather than the logic of commoning (Baer, Athanasiou, & Kartha, 2007).

Keeping in mind that the focus of this essay is the human labor mediation of nature "for nature" as distinct from the mediation of nature "for capital," Bunker's (2007) comment on the generation of use value is revealing.

> To understand the world economy as a whole and uneven development within it, we must generate models of natural production that allow us to trace the multiple interacting effects of natural and social systems. In other words, we must accord to the production

> of use-values a theoretical elaboration equal to that which Marx and others have developed for the production of exchange values. Only then can we understand the full complexity, interaction, and interdependence of both kinds of value. (p. 253)

Here, Bunker approaches a problematic raised by women several decades ago in the domestic labor debate. And just as the earlier materialist feminist analysis was constrained by the regular use and exchange value pair, so is Bunker's thinking. The perspective is also human chauvinist in that use value is actually made to represent "natural production." This classification of natural regenerative value under the human species interest in use values is an ecological blind spot. Metabolic value is not the same as humanly produced use value, though it is certainly involved when humans make use values. So too, when women labor bodily to reproduce new life, they generate metabolic value in a way that is distinct from their production of use values for private consumption in the home. Both forms of labor and value will be central to any mode of production; whereas capitalist exchange value is a historically relative form.

Vernacular Science

Scholars and political activists readily discuss the interplay of use and exchange value in economic life, but on the other side of the coin, the difference between use value and metabolic value demands further theoretical exploration. To some extent, this much-needed sociological analysis is held back by the standard sex-gendered dualism between things human and things natural, and it must be emphasized that this alienation is a patriarchal one as much as it is a capitalist one (Salleh, 1984, 1997). For example, a mystifying inversion occurs when economists speak of "embodied energy," referring to a quantity of fuel invested in a commodity from manufacture, through transport, to consumption. This idea of embodied energy anthropomorphizes the product, falsely attributing a positive economic value to what is in fact an ecological negative. That is to say, what is called embodied value is an extraction of metabolic value and as such, it contributes to metabolic rift. On the other hand, a consistent materialism will not dissociate humanity from nature in this ad hoc way. In a grounded economics, embodied energy would refer to subjective or endosomatic flows, through human labor, sexuality, and generative nature at large (Salleh, 1997, pp. 164-166, 175-178; 2009). But as things stand, reproductive activities and regenerative provisioning are disqualified and discounted in economic discourse (Waring, 1988). This leads to an unequal exchange, particularly in the case of mothering women, and it exists in parallel to the social debt or theft of surplus experienced by employed workers. The argument is not that women should receive money for giving birth, because that would be to concede a further area of everyday life to exchange value. Rather, it is a tactical transposition, directed at opening up a reflexive conversation around metabolic value, the value of the common, "a radically different scale" as glimpsed in passing by Hardt.

One English socialist describes the contemporary predicament this way:

> Turning resources into waste faster than waste can be turned back into resources puts us in global ecological overshoot. (Burton, 2009, p. 1)

Yet this ecological criticism replicates the very logic of capital that it criticizes, by reducing nature to resources, on the one side, and waste, on the other. The implication for practical change is simply a more circumspect material throughput, industry-as-usual but measured consumption. By contrast, in ecosystems there is no waste, because as long as they are not broken apart by metabolic rift, circuits of matter and energy are reciprocally constitutive. Waste is a human chauvinist notion, typical of the global North, whose hegemonic class bodily disconnects from

nature, "women's stuff," animal life, and intellectually separates ecology from economics. Another characteristic presupposition occurs in this extract from a material flow analysis:

> The productivity of labor can only be increased by simultaneously increasing the appropriation and transformation of energy stored in material forms produced in nature . . . (Bunker, 2007, p. 239)

The argument that the productivity of labor is only increased by taking more from nature is a one-dimensional zero sum equation, based on the capitalist idea of extraction as a linear chain in the mechanical manipulation of matter. The equation reflects an oppressive system, wherein a surplus must be forced either from the alienated laboring body (social debt) or forced out of raw natural resources (ecological debt). By contrast, at the domestic and geographic periphery, where the working body and mind is attuned to mediation of natural cycles, energy is not lost because meta-industrial labor is not extractive. Humans who provision in reciprocity with nature, catalyze its transfers, thereby enhancing the relational power of metabolic value.

So just how is the productivity of nature increased by reproductive labor? A close observation of meta-industrial work in action provides an answer to this. The propositions that follow derive from peasant and indigenous practices, but similar principles apply in the careful maintenance of human bodies.

The consumption footprint is small because local resources are used and monitored daily with care.

Closed loop production is the norm.

Scale is intimate, maximizing responsiveness to matter/energy transfers in nature, so *avoiding entropy*.

Judgments are built up by trial and error, using a *cradle to grave assessment* of ecosystem health.

Meta-industrial labor is *intrinsically precautionary*, because it is situated in an intergenerational time frame.

Lines of responsibility are transparent—unlike the buck passing that mars bureaucratized economies.

With community organizations being less convoluted than urban markets, *synergistic problem solving* can be achieved.

In farm settings and in wild habitat, *multicriteria decision making* is simply common sense.

Regenerative work *reconciles time scales across species* and readily adapts to disturbances in nature (Adam, 1998; Salleh, 1997, pp. 86-99).

This economic rationality *distinguishes between stocks and flows*. No more is taken than is needed.

It is an *empowering work process*, without a division between workers' mental and manual skills.

The *labor product is enjoyed or shared* whereas the industrial worker has no control over his or her creativity.

Such provisioning is eco-sufficient because it *does not externalize costs on to others as debt.*

Autonomous local economies imply *food and energy sovereignty.*

Now here is a technology to liberate all debts and debtors. Meta-industrial labor demonstrates a vernacular science, a tacit knowledge, sensuous and kinesthetic as much as visually based, a complex learned phenomenology that transcends measurement. These reproductive labors give rise to a distinct set of epistemological skills and political attitudes.

Eco-Sufficiency

If creative eco-sufficiency is second nature to grassroots communities across many regions of the global South, it is all but absent from the master discourse. Reporting to the EU, the Sustainable Europe Research Institute, Finland Futures Centre, and other consultants observed that eco-sufficiency is rarely considered by planners (Sustainable Europe Research Institute, UN University, & Finland Futures Research Centre, 2006). Rather, the capitalist mode of production is monitored by instruments such as the ecological footprint or life-cycle assessment. Most experts in sustainability science or ecological economics are ecological modernists, going for quantitative efficiency rather than qualitative eco-sufficiency (Friibergh Position, 2007). Their interest is in how to optimize land use, or the productivity of material and energy throughput. But adjustments of scale, distribution, and allocation (Daly, Erickson, & Farley, 2005) do not add up to metabolic value; neither does the precautionary principle, when it is grafted on to a materially unsustainable economy. Eco-sufficiency is very likely neglected by entrepreneurs and governments because it is threatening to capital accumulation. But factory workers and socialist theorists can be locked into productivism and its technological fixes as much as the profiteering class is. This happens when they overlook the fundamental distinction between a tool, which serves a particular intention, and a technology, which brings with it a complex of social and ecological relations (Watson, 1998).

The current financial and climate crises are consciousness-raising opportunities all round, but green new deals (World Watch Institute, 2009) designed to revive the faltering international system will delay fundamental change. In addition, many middle-class environmentalists, trade unionists, feminists, and postcolonial elites, although critical of capitalism, see no way out for themselves. Increasingly, peasant farmers are corralled into the global economy by the promise of technology transfer, indigenous peoples by mining royalties, and housekeepers by luxury goods. But meta-industrial labor has never been fully colonized by capital. In those parts of the global South where the joy of cooperative labor has survived exposure to the individualistic development paradigm, people care directly for their land, water, and biodiversity in common. Their eco-sufficiency is a strong sustainability, because organic farming adopts a human metabolic fit with nature (FAO, 2007; Mollison, 1988). Eco-sufficient provisioning protects the cultural fabric of community life because it is autonomous and flexible. Small self-managed economies are synergistic—satisfying many needs at once—learning, participation, innovation, ritual, identity, and belonging (Max-Neef, 1991).

Sociologists Brett Clark and Richard York are right to remind researchers that it is not enough simply to monitor and critique the effects of capitalism:

> Rather than perpetuating a social metabolic order that generates metabolic rifts and ecological crises, merely attempting to shift the problems around, we need to transcend this system, *to create a social metabolism that allows for nature to replenish* [italics added] and restore itself within time scales relevant to its continued re-production. (Clark & York, 2008; italics added)

This said, political ecology will remain latent as long as its analytic tools carry sociological bias, that is to say, as long as its constructs are formulated in the absence of inputs by class, race, and sex-gendered others. At professional conferences it is now mandatory to include sections on peasant and indigenous societies and to host a feminist symposium. But are these mere "add-ons" to the disciplinary hegemony? What if the suggestion were made that these marginals carry an in depth understanding of material relations that supersedes the instrumental abstraction of sustainability science? Women already speak out at forums like the International Panel on Climate Change (Hemmati, 2008), and Indigenous Peoples demand a place at the UN table (Anchorage

Declaration, 2009). These minority voices are hedging their political bets with the establishment perhaps, because they really belong in the alternative globalization movement. But here again, is the movement of movements ready to hear meta-industrial claims? Inclusivity was a live issue at the World Social Forum in Belem when the Eco-Socialist Manifesto (2009) was discussed. Have mothers or forest dwellers been too negatively constructed under capitalism to be taken seriously? Who owns the right to theorize?

The recognition of metabolic value offers an integrative political strategy for coalitions of precariously employed workers, unpaid caregivers, peasants, gatherers, and ecological activists. In some quarters, even industrial labor is reexamining taken for granted ideas about equality based on material consumption. But it is meta-industrials who constitute the largest labor class worldwide; they have the force of numbers, they have moral reason on their side, and most importantly they already know how to maintain "a social metabolism that allows for nature to replenish." In Engels's (1969) words,

> . . . freedom does not consist in the dream of independence from natural laws, but in the knowledge of these laws . . . real human freedom [requires living] an existence in harmony with the laws of nature that have become known. (pp. 136-138)

The real material bottom line of any social metabolism is ecological integrity—a recursive web of self-regulating matter/energy flows signified by metabolic value. The small nation of Ecuador, guided by indigenous peoples, already prefigures this conceptual shift in its new Constitution—a document that defies old Eurocentric dualisms by giving juridical rights to nature. As Article 1 reads,

> Nature or Pachamama, where life is re-produced and exists, has the right to exist, persist, maintain and regenerate its vital cycles, structure, functions and its processes in evolution . . . Every person, people, community or nationality, will be able to demand the recognition of rights for nature before the public institutions. (Ecuador Constitution, 2008)

This legal breakthrough is an invitation to sociologists and to alternative globalization activists, to further articulate the meaning of metabolic value, endorsing its place as the material centre of sound provisioning and common governance.

Declaration of Conflicting Interests

The author(s) declared no conflicts of interest with respect to the authorship and /or publication of this article.

Funding

The author(s) received no financial support for the research and/or authorship of this article.

Notes

1. A fair portion of my own work has been dedicated to arguing that feminist thinking about ecology is held back by a failure to distinguish between materiality and ideology in the capitalist rationalization of women's exploitation as "closer to nature." This distinction is prerequisite to an understanding of how these orders of everyday life are at once interactive and relatively autonomous.
2. The Alliance for Green Revolution in Africa (AGRA) is a massive consortium consisting of The African Union's New Economic Partnership for Africa's Development (NEPAD) and Comprehensive Africa Agriculture Development Program (CAADP); the pro-GM Consultative Group on International Agricultural Research (CGIAR) with multiple university research centres; the US Millennium Challenge

Corporation aiming for ‘rapid and sustainable smallholder growth’; the African Development Bank (ADB); FAO; Rockefeller Foundation; Gates Foundation; The Consultative Group to Assist the Poor (CGAP).

References

Adam, B. (1998). *Timescapes of modernity: The environment and invisible hazards*. London, England: Routledge.

Anchorage Declaration. (2009, April). Indigenous people’s global summit on climate change [Online posting]. ENVIROSOC@listserve.brown.edu

Baer, P., Athanasiou, T., & Kartha, S. (2007). *The right to development in a climate constrained world: The greenhouse development rights framework*. Washington, DC: Heinrich Boell Stiftung. Retrieved from http://www.ecoequity.org/GDRs

Bello, W. (2002). *Deglobalization: Ideas for a new world economy*. London, England: Zed Books.

Bennholdt-Thomsen, V., Faraclas, N., & von Werlhof, C. (Eds.). (2001). *There is an alternative: Subsistence and worldwide resistance to corporate globalization*. London, England: Zed Books.

Bunker, S. G. (2007). Natural values and the physical inevitability of uneven development under capitalism. In A. Hornborg, J. R. McNeill, & J. Martinez-Alier (Eds.), *Rethinking environmental history: World-system history and global environmental change* (pp. 239-258). Lanham, MD: AltaMira Press.

Burkett, P. (1997). Nature in Marx reconsidered. *Organization & Environment, 10*, 164-184.

Burkett, P. (1999). *Marx and nature: A red and green perspective*. New York, NY: St. John’s Press.

Burton, M. (2009, August 1). Sustainability: Utopian and scientific. *21st Century Socialism*. Retrieved from http://21stcenturysocialism.com/article/sustainability_utopian_and_scientific_01880.html

Clark, B., & York, R. (2005). Dialectical materialism and nature. *Organization & Environment, 18*, 318-338.

Clark, B., & York, R. (2008, November). Rifts and shifts: Getting to the roots of environmental crises. *Monthly Review*. Retrieved from http://www.monthlyreview.org/081124clark-york.php

Clausen, R., & Clark, B. (2005). The metabolic rift and marine ecology. *Organization & Environment, 18*, 422-445.

Commoner, B. (1971). *The closing circle*. New York, NY: Knopf.

Dalla Costa, M., & James, S. (1972). *The power of women and the subversion of the community*. Bristol, England: Falling Wall Press.

Daly, H., Erickson, J., & Farley, J. (2005). *Ecological economics: A workbook for problem based learning*. Washington, DC: Island Press.

Eco-Socialist Manifesto. (2009). Retrieved from http://www.ecosocialistnetwork.org/#Belem

Ecuador Constitution. (2008, September 10). Ecuador: Nature has rights, *Green Left Weekly*. Retrieved from http://www.climateandcapitalism.com

Engels, F. (1969). *Anti-Dühring*. Moscow, Russia: Progress.

Europa. (2007). *EU initiative for a knowledge based bio-economy (KBBE)*. Retrieved from http://www.europa.eu.int/comm/research/biosociety

FAO. (2007). *Report of the International Conference on Organic Agriculture and Food Security*. Rome, Italy: Author.

Federici, S. (1999). Reproduction and feminist struggle in the new international division of labor. M. Dalla Costa & G. F. Dalla Costa (Eds.), *Women, development and labor of reproduction: Struggles and movements* (pp. 47-82). Trenton, NJ: Africa World Press.

Foster, J. B. (1997). The crisis of the earth. *Organization & Environment, 10*, 278-296.

Foster, J. B. (1999). Marx’s theory of metabolic rift: Classical foundations for environmental sociology. *American Journal of Sociology, 105*, 366-405.

Foster, J. B. (2000). *Marx’s ecology: Materialism and nature*. New York, NY: Monthly Review Press.

Friibergh Position. (2007). *On eco-sufficiency*. Retrieved from http://www.earthethics.com/sustainability%20science.htm

Gibson-Graham, J. K., Resnick, S., & Wolff, R. (Eds.). (2000). *Class and its others*. Minneapolis: University of Minnesota Press.

Hardt, M. (2009). On the politics of the common(s) [Web log name]. Reimagining society project hosted by ZCommunications, reported by Michel Bauwens, P2P Foundation. Retrieved from blog.p2pfoundation.net/michael-hardt-for-a-politics-of-the-common/2009/

Hardt, M., & Negri, A. (2004). *Multitude: War and democracy in the age of empire*. New York, NY: Penguin.

Hawken, P., Lovins, A. B., & Lovins, L. H. (1999). *Natural capitalism: The next industrial revolution*. London, England: Earthscan.

Hemmati, M. (2008, February). GenderCC: Women for climate justice. Emergency issues panel, UN Commission on the status of women, 52nd Session.

Hornborg, A., McNeill, J. R., & Martinez-Alier, J. (Eds.). (2007). *Rethinking environmental history: World-system history and global environmental change*. Lanham, MD: AltaMira Press.

Illich, I. (1977). *Energy and equity*. New York, NY: Boyars.

Isla, A. (2009). Who pays for Kyoto protocol? In A. Salleh (Ed.), *Eco-sufficiency & global justice: Women write political ecology*. London, England: Pluto Press.

Johnsson-Latham, G. (2006). *Initial study of lifestyles, consumption patterns, sustainable development and gender*. Stockholm, Sweden: Ministry of Sustainable Development.

Martinez-Alier, J. (2002). *The environmentalism of the poor*. Cheltenham, England: Elgar.

Marx, K. (1976). *Capital* (Vol. 1). New York, NY: Vintage.

Marx, K. (1991). Capital (Vol. 3). New York, NY: Penguin.

Max-Neef, M. A. (1991). *Human scale development*. New York, NY: Apex.

Mertes, T. (Ed.). (2004). *The movement of movements*. London, England: Verso.

Mies, M. (1986). *Patriarchy and accumulation on a world scale*. London, England: Zed Books.

Mol, A. P. J., & Sonnenfeld, D. (Eds.). (2000). *Ecological modernization around the world*. London, England: Frank Cass.

Mollison, B. (1988). *Permaculture: A designer's manual*. Tyalgum, New South Wales, Australia: Tagari.

Morales, E. (2010). Call to the people's world conference on climate change and mother earth rights, Cochabamba, Bolivia. Retrieved from http://www.boliviaun.org/cms

Mujeres Manifesto. (2009). First continental summit of indigenous women. Lucha Indigena, No. 34.

NEPAD. (2009). Retrieved from http://www.nepad-caadp.net

Planet Diversity. (2008, May). Manifesto, Bonn, at Women and Life on Earth. Retrieved from http://www.wloe.org

Quito Statement. (2007, August). South peoples historical social-ecological debt creditors alliance, Quito Statement [Online posting]. ieetm@accionecologica.org

Rose, D. (2008). Fitting into country. *Capitalism Nature Socialism, 19*(3), 117-121.

Rosewarne, S. (2004). Globalization and the recovery of the migrant as subject, *Capitalism Nature Socialism, 15*(3), 37-52.

Salleh, A. (1984). Contribution to the critique of political epistemology. *Thesis Eleven, 8*, 23-43.

Salleh, A. (1997). *Ecofeminism as politics: Nature, Marx, and the postmodern*. London, England: Zed Books.

Salleh, A. (2004). Globalization and the meta-industrial alternative. In R. Albritton, S. Bell, J. R. Bell, & R. Westra (Eds.), *New socialisms: Futures beyond globalization* (pp. 201-210). London, England: Routledge.

Salleh, A. (2006). Organised irresponsibility: Contradictions in the Australian Government's strategy for GM regulation. *Environmental Politics, 15*, 388-416.

Salleh, A. (Ed.). (2009). *Eco-sufficiency & global justice: Women write political ecology*. London, England: Pluto Press.

Salleh, A., & Hanson, M. (1999). On production and re-production; identity and non-identity. *Organization & Environment, 12*, 207-218.

Sargent, L. (Ed.). (1981). *Women and revolution*. Boston, MA: South End Press.

Schnaiberg, A., Pellow, D. N., & Weinberg, A. (2002). The treadmill of production and the environmental state. In A. P. J. Mol & F. Buttel (Eds.), *The environmental state under pressure* (pp. 15-32). Oxford, England: Elsevier.

Shiva, V. (1989). *Staying alive: Women, ecology, and development*. London, England: Zed Books.

Smith, J., Karides, M., Becker, M., Brunelle, D., Chase-Dunn, C., della Porta, D., Icaza Garza, R., Juris, J., Mosca, L., Rees, E., Smith, P., & Vazquez, R. (2007). *Global democracy and the world social forums*. Boulder, CO: Paradigm.

Solidarity Economy. (2009). *Solidarity economy and the commons meeting in Graz*. Retrieved from http://www.aloe.socioeco.org.

Sustainable Europe Research Institute, UN University, & Finland Futures Research Centre. (2006). *Environment and innovation*. Vienna, Austria: Author.

Third World Network. (2009). Retrieved from http://www.twnside.org.sg

Via Campesina. (2007). Small scale sustainable farmers are cooling down the earth [Online posting]. via-info-en@googlegroups.com

Via Campesina–European Coordination. (2009). Reclaim the fields: European camp to cultivate alternatives, September-October, Minerve, France [Online posting] viacampesina@viacampesina.org

Wackernagel, M., & Rees, W. (1996). *Our ecological footprint*. Gabriola Island, British Columbia: New Society.

Wallis, V. (2008, November). Capitalist and socialist responses to the ecological crisis. *Monthly Review*. Retrieved from http://www.monthlyreview.org/081103wallis.php

Waring, M. (1988). *Counting for nothing*. Sydney, New South Wales, Australia: Allen & Unwin.

Watson, D. (1998). *Against the megamachine: Essays on empire and its enemies*. New York, NY: Autonomedia.

World Watch Institute. (2009). *Towards a trans-Atlantic green new deal: Tackling the climate and economic crises*. Brussels, Belgium: Heinrich-Boell Stiftung.

York, R., & Rosa, E. (2003). Key challenges to ecological modernization theory. *Organization & Environment, 16*, 273-288.

Bio

Ariel Salleh is a researcher in political economy at the University of Sydney. She has experience in water and biodiversity conservation, green party and global movement politics, care giving, science for people activism, and from 2001 to 2004 she served on the Australian Government's Gene Technology Ethics Committee. Formerly associate professor in Social Inquiry at the University of Western Sydney, she has lectured in the United States, Europe, and Asia. A coeditor of *Capitalism Nature Socialism* and board member of *Organization & Environment*, her publications include *Ecofeminism as Politics*, *Eco-Sufficiency & Global Justice*, and many articles (www.arielsalleh.net).