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METABOLIC PROFILES OF COUNTRIES AND ECOLOGICAL DISTRIBUTION CONFLICTS[1]

"Social metabolism" is a notion that links up the natural sciences and the social sciences, and also human history. Work has been done by some groups in Europe in order to operationalize the old idea of looking at the economy from the point of view of "social metabolism". That idea arose in the 1850s. (Marx used the word *Stoffwechsel*, and referred explicitly to the metabolism of cells and organisms which also existed in human society. However, neither himself nor Marxist authors did calculations of the use of materials and energy in the economy). The ideas in the late 19th century and early 20th century of other European authors such as S.A. Podolinsky, L. Pfaundler, J. Popper-Lynkeus, P. Geddes are now recognized as harbingers of today's Ecological Economics and Industrial Ecology. Around 1910 Lotka (writing in German in Wilhelm Ostwald's journal) introduced the distinction between the endosomatic consumption of energy and the exosomatic use of energy by humans. "Social metabolism" expresses the idea that an economy is like an organism that takes resources from the outside and discharges wastes.[2]

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United Nations University, Tokyo, 25 Nov., and IEG, University of Delhi, 7 Dec. 2004

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J. Martinez-Alier, *Ecological Economics*, Blackwell, Oxford, 1987. A review of the intellectual history has been done by Fischer-Kowalski, M. (1998), Society's Metabolism. The Intellectual History of Material Flow Analysis, Part I,1860-1970, *Journal of Industrial Ecology*, vol.2 (1), 61-78; and Fischer-

Kowalski, M (1998), Society's Metabolism. The Intellectual History of Material Flow Analysis, Part II, 1970-1998, *Journal of Industrial Ecology*, vol.2 (4), 107-136. A similar job for the history of the study of the flow of energy in human societies has been done by Helmut Haberl, "The Energetic Metabolism of Societies. Part I: Accounting Concepts", "The Energetic Metabolism of Societies, Part II: Empirical Examples", *Journal of Industrial Ecology* 5(2), 2001.

"Metabolic profiles" of countries or regions are today established by the figures provided by MEFA (Material and Energy Flow Accounting) and HANPP (Human Appropriation of Net Primary Production). The level of development, the geography of each country or region, the external commercial relations, the changing technologies and environmental regulations explain the specific "metabolic profiles". This paper is an attempt to consider the links between each society's characteristic metabolic profile and the ecological distribution conflicts, at different scales (international, national, regional).

Research on Material and Energy Flow Accounting, and also on the Human Appropriation of Net Primary Production (of biomass) (HANPP) has advanced somewhat. Statistical offices including Eurostat are now publishing statistics on Material Flows for European Union countries (1980-2000), with an agreed methodology that follows the principles developed through discussions between groups in Europe (mainly the Wuppertal Institut and the Sozial Oekologie group at the IFF, Vienna). Neither Eurostat nor the European Environment Agency had initially any idea on how to proceed. The OECD is also sponsoring work on Material Flows and in general on physical indicators of (un)sustainability.

The HANPP is calculated in three steps. First, the potential net primary production (in the natural ecosystems of a given region or country), NPP, is calculated. Then we calculate the actual net primary production (normally, less than potential NPP, because of agricultural simplification, soil sealing etc.), and then we calculate which part of actual NPP is used by humans and associate beings (cattle, rats, etc.: this is the HANPP). In terrestrial ecosystems, the ratio between HANPP and potential NPP seems to be around 40% worldwide, but of course this is indeed a rough figure. The HANPP is meant to be an index of loss of biodiversity (because the higher the

HANPP, the lower the biomass available for "wild" species), and this assumed relation is in itself a topic for research. [3]

These are some references: a) Krausmann F., Haberl H., Schulz N. B., Erb K.-H., Darge E., Gaube V.: Land-Use Change and Socio-Economic Metabolism in Austria, Part I: Socio-Economic Driving Forces of Land-Use Change 1950-1995. In: *Land Use Policy*, 20 (2003), 1, pp. 1-20. b) Haberl H., Erb K.-H., Krausmann F., Adensam H., Schulz N. B.: Land-Use Change and Socio-Economic Metabolism in Austria, Part II: Land-Use Scenarios 1995-2020. In: *Land Use Policy*, 20

The relations between energy and the economy have been much discussed. There is research on the trend of EROI (energy return on energy input), that is the energy costs of obtaining energy (in different systems: wind energy, tar sands ...), and its implications for the economy. Thus, one may question the use in Europe of biomass energy when it comes from agricultural systems that are perhaps increasingly inefficient in terms of energy. At world level there has *not* been a breakthrough in energy systems, all sources go up. [4] **Biomass energy at least doubled in the 20th century, coal increased six times, oil and gas increased many times more... Robert Ayres (the "father" of Industrial Ecology) has co-authored recent work showing a close long-run relation in the United States between growth of energy input in the economy (in terms of work done) and growth of GNP. Several groups are working on this topic in different European countries.** [5]

Still another idea for a single index of (un)sustainability, the "ecological footprint" (Rees and Wackernagel), thrives as a didactic and political instrument. It has merit and success as a communication device, but it should not make it to the level of official statistics because the "ecological footprint" contains information that largely duplicates the energy (food, biomass and fossil fuels) statistics, through it is presented in attractive spatial terms that explain its success.

Trade and material flows

In 1884, Patrick Geddes (who in the 1910s and 1920s was to be an urban planner in India), proposed the construction of a sort of input-output table inspired by the

Tableau Economique of the Physiocrat François Quesnay. The first column would

(2003), 1, pp. 21-39. c) Haberl H., Schulz N. B., Plutzar C., Erb K.-H., Krausmann F., Loibl W., Moser D., Sauberer N., Weisz H., Zechmeister H., Zulka P.: Human Appropriation of Net Primary Production and Species Diversity in Cultural Landscapes: Empirical Analyses for an Austrian Transect. In: *Agriculture, Ecosystems & Environment* (2003).

[4] **John McNeill, *Something new under the Sun – an environmental history of the 20th century*, Norton, New York, 2000.**

Robert U. Ayres & Benjamin Warr, Accounting for Growth: the Role of Physical Work, *Advances in Energy Studies* (ed. by Sergio Ulgiati), SGEditoriali, Padova, 2003.

contain the sources of energy as well as the sources of materials which are used, not for their potential energy, but for their other properties. Energy and materials were transformed into products through three stages, extraction, manufacture, transport and exchange. Estimates were needed of the losses (dissipation and disintegration) at each stage. The quantity of the final product (or "net" product, in Physiocratic terms) might seem surprisingly small in proportion to the gross quantity of potential product. Now, however, the losses at each stage were not accounted for in economic terms. The final product was not added value at all. It was the value remaining from the energy and materials available at the beginning once they had been through all three stages.

Geddes' scheme is relevant to the attempt by several authors to develop today a theory of ecologically unequal exchange between the metropolitan centres (the EU, Japan, the USA), and the world peripheries. In neoclassical economics, provided that markets are competitive and ruled by supply and demand, there cannot be unequal exchange. This could only arise from monopoly or monopsony conditions, or because of non-internalized externalities (or excessive discounting of the future). In an ecological-economics theory of unequal exchange, one could say that the more of the original exergy [available energy or "productive potential" in the exported raw materials] has been dissipated in producing the final products or services (in the metropolis), the higher the prices of these products or services. This was indeed implied by Geddes with different words. Thus, Hornborg concludes, "market prices are the means by which world system centres extract exergy from the peripheries",

sometimes helped, one must say, by military power.[6] The European Union (15 countries) imports about four times more tons than it exports – environmental burdens are displaced elsewhere. Latin America exports six times more tons than it imports.[7]

[6] **A. Hornborg, Towards an ecological theory of unequal exchange: articulating worls system theory and ecological economics, *Ecological Economics,* 25, 1998.**
Giljum S.; Eisenmenger N. (2004), North-South Trade and the Distribution of Environmental Goods and Burdens: a Biophysical Perspective, *The Journal of Environment & Development,* March 2004, vol. 13, no. 1, 73-100). Not all developing countries are net physical exporters – India and China are probably net importers (because of oil imports). See M. Fischer-Kowalski, C. Amann C., Beyond IPAT and Kuznets Curves: globalization as a vital factor in analysing the environmental impact of socio-economic metabolism, *Population and Environment,* Vol 23, n.1, 2001.

Water social-metabolism is a topic by itself. Water enters in social metabolism in large quantities (100 times more in terms of weight than the MF). Consider for instance the dumping of waste into water, the exhaustion or pollution of aquifers, the energy and environmental impacts of new large desalination projects. There is also an interesting discussion on "virtual water" (i.e. the water "cost" of different products). In the present paper, water is left aside.

Material flows and metabolic profiles

Metabolic profiles may be established (as regards Material Flows) for nations or regions, using the Eurostat methodology in order to ensure comparability with other similar analyses conducted for different countries.[8] In this framework, a complete balance of an economy can be carried out by taking into account what crosses the system's boundaries. The net accumulation of materials in a system can be calculated as the difference between what enters (inputs) the system and what goes out (outputs). According to the Eurostat classification, material flows can be domestic, if extracted from the system, or ROW, if coming from the Rest Of the World. ROW material flows can be direct or indirect. The former enter directly into the system while the latter -the "ecological rucksack", as Schmidt-Bleek called

Early relevant literature is the following: Bringezu, S., Schütz, H. (2001), ***Total Material Requirement of the European Union*****. In: European Environmental Agency (ed).** ***Technical Report No 55*****, EEA, Copenhagen. Also EUROSTAT (2001),** ***Economy-wide material flow accounts and derived indicators - a methodological guide.*** **Luxembourg: Office for Official Publications of the European Communities. Also, the well known report by Adriaanse, A., Brigenzu, S, Hammond, A., Moriguchi, Y., Rodenburg, E., Rogich, D. Schütz, H. (1997),** ***Resource Flows. The material basis of industrial economies.*** **Washington DC: World Resources Institute, later updated in Matthews, E., Amann, C., Brigenzu, S., Fischer-Kowalski, M., Hütler, W., Kleijn, R., Moriguchi, Y., Ottke, C., Rodenburg, E., Schandl, H., Schütz, H. van den Voet, E., and Weisz, H. (2000),** ***The weight of nations. Material outflows from industrial economies.*** **Washington DC: World Resources Institute. In this second report there was already an Austrian contribution, based on Schandl, H.; Weisz, H.; Petrovic, B. (2000), Materialflussrechnung für Österreich 1960 bis 1997. In:** ***Statistische Nachrichten*** **55 (NF)(2): 128-137.**

them- are linked to the production of goods, even if these resources are later not exchanged in the market. In addition, both direct domestic and ROW material flows can be used and unused. The latter represent materials extracted or discarded during the production of a good, i.e. mining overburden, while the term used refers to an input for use in the economy. Focus should be on direct material inputs, because indirect flows increase the comprehensiveness of the analysis but they also increase its arbitrariness. This is because indirect flows are calculated by multiplying direct flows by standard coefficients. However, in reality they vary considerably depending on the state of technology and the economic conditions of a country. Moreover, if indirect flows are accounted for, comparisons between countries may imply double-counting internationally traded goods since indirect flows are accounted for twice –in both the exporting and the importing country.

It should be noted as well, that in the Material Flow Accounting water and air are excluded (although the water and air content present in materials are included).

In the Eurostat methodological guide, material flows are classified into three main material groups (minerals, energy and biomass) and into three main categories (imports, exports and domestic extraction), which are used to structure the indicators calculated. (Fig. 1). Part of the waste produced by economies is recycled outside markets by natural cycles, a small part is recycled by markets (some paper, metals).

The amounts and proportions change with time, with income, and with the physical profiles of the economies in question.

Further subdivisions could be done so as to determine in more detail the Metabolic Profile of a country or region inside the country, and then try to link up such Metabolic Profiles to concrete environmental conflicts and remedial measures.

. **• Domestic Extraction: materials extracted in the national territory per year.**
. **• Direct Material Input (DMI): Domestic Extraction (DE) plus Direct Material Imports (I) (DMI=DE+I).**
. **• Domestic Material Consumption (DMC*):* DMI minus Direct Material Exports (E) (DMC=DMI-E=DE+I-E).**

Taking, for instance, the MFA of Spain[9] a number of conclusions concerning the relationship between the Spanish economy and its surrounding environment can be drawn. First, the Spanish economy shows no signs of dematerialization. On the contrary, the total mass of material moved by the Spanish economy (i.e. DMI = domestic extraction plus direct material imports) increased by 85% from 1980 to 2000, whereas GDP increased by 74%. Thus, Spain's trend towards convergence of income per capita within the European Union is matched by its "race to the top" in terms of materials.

Thus, one immediate research question would be, which level of income is required, with which technological patterns and external physical trade relations, to start on the path of at least "weak" dematerialization? While in other European countries there has been at least relative dematerialization, in Spain it is not so. In this sense, the Spanish trend is typical of developing economies, it does not yet follow the performance of mature industrialised countries.

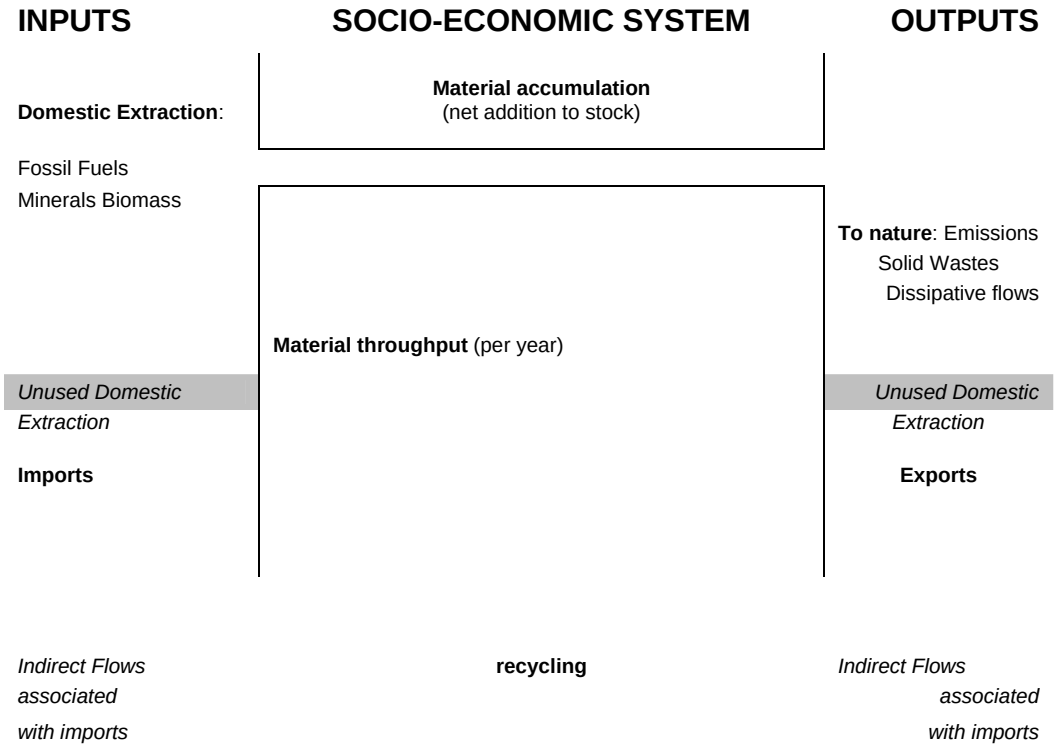
Second, in Spain domestic extraction (DE), consumption (DMC) and material input (DMI) in the economy have evolved in line with the economic cycles. Therefore, there is no evidence of a decoupling trend between economic growth and material use. The growth of building materials is comparatively remarkable as also the increase in

energy materials (despite the decline of domestic coal extraction). Probably, the importance of the building sector is reflected in the comparatively very rapid rates of *soil sealing* in some regions of Spain. Soil sealing (*Land Verbrauch*) is relevant for the calculation of HANPP.

Third, the Spanish economy has become increasingly dependent on international trade. Imports double exports in terms of weight. In other words, Spain is using more and more natural resources from other economic systems to increase its welfare possibly displacing environmental loads to poorer countries. (Fig. 2 and 3). The dependence on energy imports has become a key characteristic of the Spanish economy. Also, metals that used to be domestically produced are now imported.

9 **S. Cañellas, A.C. González, I. Puig, D. Russi, C. Sendra, A. Sojo, Material Flow Accounting of Spain, forthcoming in *International Journal of Global Environmental Issues*, 2004. I am much**

Figure 1. Economy-wide material balance (excluding air and water)



The increase in material flows reveals an increase in the consumption of internal and external resources, some of them causing high environmental impacts during extraction, transport, use or waste disposal. Thus, one may understand that in one country or region conflicts appear on the siting of quarries or on new transport infrastructures, while in another country or region conflicts arise on oil or gas extraction.

indebted to this is work done at ICTA-UAB under guidance from Heinz Schandl and Helga Weisz, IFF, Vienna.

Obviously, such research is of importance at world level given the fact that developing economies are getting locked into technological and consumption

Fig. 2. The Spanish economy: not even weak dematerialization

year

patterns (based on fossil fuels) similar to the European ones.

Figure 3. Net Imports for Spain (1980-2000) (imports- exports)

year

Comparisons between European countries and developing countries

Material Flow Accounting (MFA) and HANPP are recognized as key tools to assess the metabolism of societies and to provide aggregated indicators for environmental pressures of human activities. Work has been done in the last few years by the

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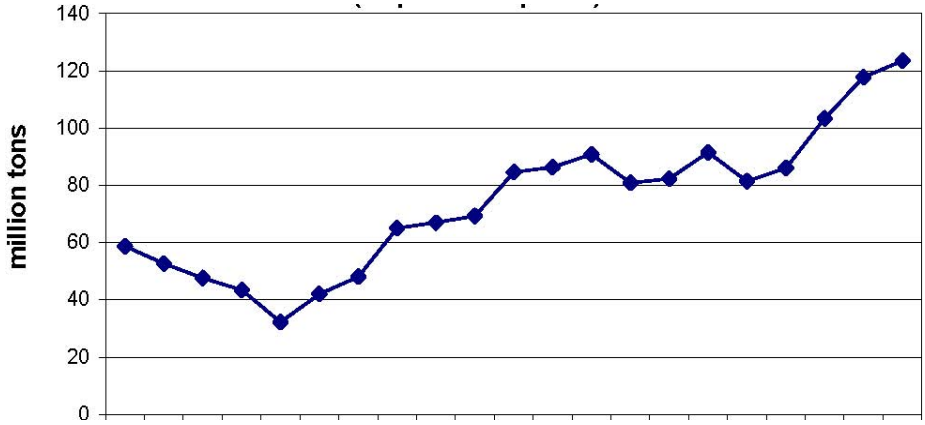

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Fig. 2. The Spanish economy: not even weak dematerializa

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Social Ecology group in Vienna and partners, on the "metabolic profiles" not only of European countries but also of some Latin American and South-East Asian countries. As one example, we summarize a study on Chile.[10] The paper analyses the restructuring of the Chilean economy towards an active integration in the world markets from the perspective of natural resource use in a time series from 1973 to 2000. Results show that material inputs to the Chilean economy increased by a factor of six, mainly due to the promotion of resource-intensive exports from mining, fruit planting, forestry and fishery sectors. With over 40 tons, Chile's resource use per capita at present is one of the highest in the world.

European socio-metabolic profiles cannot be understood apart from our relations with the rest of the world. This also applies to many other countries. Thus, Japan has a metabolic profile very different from Indonesia. The different regions of India, Brazil, the European Union or any other large country have very different metabolic profiles. Some types of imports into Europe (or Japan) might imply high levels of pollution and environmental degradation in the countries from which these materials are extracted. These hypotheses are to be confirmed in further contemporary and historical analyses on environmental pollution terms of trade, and carbon terms of trade.[11] Thus, a less carbon-intensive European economy is not necessarily a good thing, for two reasons. Intensity improvement is compatible with larger absolute production of carbon dioxide, depending on the growth of GDP. Also, internal relative

(or absolute) decrease in carbon dioxide production may be perhaps explained by changes in trade currents and composition.

Testing the dematerialization hypothesis

There is a burgeoning literature on the topic of *Environmental Kuznets Curve (EKC)*, a hypothesis based on the idea that economic and technological

[10] **Stefan Giljum, Trade, material flows and economic development in the South: the example of Chile. *Journal of Industrial Industrial Ecology* 8 (1-2), 241-261, 2004.**

[11] **Muradian, R., O' Connor, M., Martínez-Alier, J,. (2002), Embodied Pollution in Trade: Estimating the 'Environmental Load Displacement' of Industrialised Countries. *Ecological Economics*, 41, 51-67. Muradian, R., Martínez-Alier, J. (2001), Trade and the Environment from a Southern Perspective. *Ecological Economics*, 36. 281-297.**

development allows for the reduction of environmental impact of societies. Usually, diverse forms of air pollution have been taken as indicators. For instance, urban sulphur dioxide emissions go down after a certain level of economic growth.[12] If verified, this hypothesis would lead to important political consequences, in the sense that following the present development path will lead to the disappearance of some conflicts and to a more sustainable economic system.

Material flow accounting, disaggregating the flows into various components (fossil fuels, biomass, other minerals) can be used to test different aspects of the EKC hypothesis. Does the EKC apply to biomass, does it apply to the different fossil fuels, and therefore to different sources of carbon emissions? In fact, the dematerialization hypothesis can be seen as a different formulation of the EKC.

As we have seen, once we have historical series on Material Flows, these can be

used to test the *dematerialization hypothesis*, the idea that technological progress and the shift towards an economy based on services more than on industry, causes a decrease in total materials used (strong dematerialization) or in materials used per monetary unit of output (at constant prices) (weak dematerialization).

One of the variables analysed in relation to income growth is land use, and soil sealing. Relatedly, the question could be researched across Europe (and outside Europe) of whether there is an EKC for HANPP.

Also, one main research objective should be the modelling of the relations between such variables.[13] For instance, an increase in the use of fossil fuels (introduction of

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Discussion of the EKC from the critical side, Bruyn, S.M., Opschoor, J.B. (1997), Developments in the throughput-income relationship: theoretical and empirical observations. *Ecological Economics*, 20, 255-268. Rothman, D.S. (1998), Environmental Kuznets Curves - real progress or passing the buck? A case for consumption-based approaches, *Ecological Economics, 25,* 177-194..

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Haberl, H.; Fischer-Kowalski, M.; Krausmann, F.; Weisz, H.; Winiwarter, V. (2004): Progress Towards Sustainability? What the conceptual framework of material and energy flow accounting (MEFA) can offer. *Land Use Policy* 21(3). Krausmann, F.; Haberl, H.; Erb, K.; Wackernagel, M. (2004): Resource flows and land use in Austria 1950-2000: Using the MEFA framework to monitor society-nature interaction for sustainability. *Land Use Policy* 21(3).

LPG) is linked to a slight decrease in HANPP, and therefore, perhaps to less pressure on wild biodiversity (so that in India, LPG would be good for the tigers). Here there is a non-linear trade-off between net carbon dioxide emissions and biodiversity conservation, which will depend also on population growth and on the use of biomass not as domestic fuel but as fuel for engines.

One would like to be able to argue, as Indira Gandhi did in 1971, that less poverty always implies a better environment. In today's language, we would always be in a win-win, downward EKC in which income growth goes together with better environmental quality. There might be one type of "lose-lose" economic growth that increases both local poverty and environmental degradation, for instance the expropriation in India of tribal people to the benefit of open cast coal or bauxite mining. There might be a contrary situation, which would prove Indira Gandhi right: economic growth allows the rural people to move up in the domestic energy "ladder" decreasing the pressure on fuelwood and dung and improving also the domestic health environment. [14]

So, as regards the use of biomass for energy, there are two opposite situations (with contrary effects on HANPP). In the North, the doubtful and limited substitution of biomass energy (whether domestic or imported) for fossil fuels. In the South (and in European history), the substitution of fossil fuels for biomass (domestic cooking and heating) energy. However, also in the South, HANPP might increase again because of the growth of "bio-diesel plantations" as an additional contribution to the energy system. [15]

Metabolic profiles and Environmental conflicts

In India, use of biomass for domestic fuel will decrease in importance over the next few years as LPG becomes more affordable (in 2003 in Orissa a 14 kg bottle of LPG cost about 270 rupees, while the rural daily wage was below 50 rupees, i.e. below one euro). J. Martinez-Alier, Introduction to new edition of *The Environmentalism of the Poor*, Oxford U.P., Delhi, 2005.

[15] **Thus, one can read that "state-initiative (is) sought for bio-diesel plantations" in Andhra Pradesh (*The Hindu*, Hyderabad, 22 Nov. 2004). Also for ethanol from sugar cane, in other regions.**

Political Ecology has been defined as the study of ecological distribution conflicts, i.e. conflicts on the access to natural resources and services and on the burdens of

pollution. Many of these conflicts are outside the market. However, the prices in the economy depend very much on the outcomes of such conflicts. [16] **The names of conflicts have been given by authors who have studied them, or have arisen from the world of NGO. Take a name like "biopiracy" - in a way, the fact is not new at all, it has been going on for 500 years; however, it is a new insulting name which reveals a sense of injustice, felt by some and denied by others.**

Taking a socio-metabolic view of the economy, we can then classify ecological distribution conflicts according to the different points in the "commodity chains" where they occur. It might be at the point of extraction of materials and energy, or in manufacture and transport, or finally in the disposal of the waste.

Conflicts on the extraction of materials and energy

1.- Mining conflicts. Complaints over mines and smelters because of water and air pollution, and land occupation by open-cast mining and slag. (Many such conflicts are historical, e.g. Ashio in Japan or Rio Tinto in Southern Spain c. 1900). Also, conflicts on oil and gas extraction. (Networks active in 2004: Mines, Minerals and People / Oilwatch). In the growing economy of India, there are conflicts on the mining of coal, iron ore, uranium, bauxite. There are complaints against national public or private companies but also against transnational companies (e.g. the Alcan and Vedanta current projects for bauxite mining in the Rayagada and Kalahandi districts of Orissa). There are also conflicts on the extraction of building materials (including killing of revenue officials who try to stop the quarrying of sand, *The Hindu*, 17 Dec. 2004).

2.- Biopiracy. The appropriation of genetic resources ("wild" or agricultural) without adequate payment or recognition of peasant or indigenous ownership over

16 **Ecological distribution conflicts and related resistance movements were listed in R. Guha and J. Martinez-Alier, *Varieties of Environmentalism*, Oxford U.P., Delhi, 1998, as the evolving agenda of Political Ecology. That list is here expanded and rearranged.**

them (including the extreme case of the Human Genome project). This word was introduced by Pat Mooney, of RAFI, c. 1993.

3.- Land Degradation. Soil erosion caused by unequal distribution of land, or by pressure of production for exports. Blaikie and Brookfield introduced the basic distinction between pressure of population and pressure of production on the sustainable use of land.[17]

4.- Plantations are not Forests. All around the world, some groups complain against eucalyptus, pine, acacia plantations for wood or paper pulp production (often exported).[18] **There is a link between the growth of the material flows of biomass and the growth of such conflicts.**

5.- Mangroves vs shrimp. The movement to preserve the mangroves for livelihood, against the shrimp export industry, in Thailand, Honduras, Ecuador, Brazil, India, Philippines, Bangladesh, Sri Lanka, Indonesia...

6.- National / local fishing rights. Other forms of use of biomass give rise to other conflicts. Thus, there are national and local fishing conflicts. Hence the attempts to stop open access depredation by imposing (since the 1940s in Peru, Ecuador, Chile) exclusive fishing areas. The language here is international public law. Another conflicts is that of the defence (or introduction) of local communitarian fishing rights against industrial fishing (as in coastal India, or the lower Amazonia).

7.- Water conflicts.[19] **Thus, in India the movements against large dams for hydroelectricity or irrigation, such as the Narmada movement, and also new conflicts, as in Pulichintala (Andhra Pradesh), or in the North-East, and in other places if the project of "interlinking of the rivers" goes forward. In Brazil there is an organized movement of *atingidos por barragens*. Also, conflicts on the use and**

[17] **P. Blaikie and H. Brookfield, *Land Degradation and Society*, Methuen, London, 1987.** [18] **R. Carrere and L. Lohman, *Pulping the South: Industrial Tree Plantations and the World Paper Economy*, Zed, London, 1996, and the website, wrm.org.uy** [19] **P. McCully, *Silenced Rivers: The Ecology and Politics of Large Dams*, Zed, London, 1996, and the website of the International Rivers Network.**

pollution of aquifers (of which the Plachimada conflict in Kerala between farmers and the Coca-Cola company has become world famous).

Conflicts on transport

8.- Transport conflicts are on the increase because of the larger and larger use of materials in the economy. Examples are complaints over oil spills from tankers or from pipelines, complaints over new motorways, harbours and airports, also over "hidrovías" (such as Paraguay-Paraná)... There are many conflicts on transport. (For instance, the Sethusamundram Ship Canal Project between Tamil Nadu and Sri Lanka would shorten navigation times between the east and west coats of India, but it also constitutes a perceived threat to the local fisheries because of dredging and sand dumping). In the 20th century and at present physical indicators for transport (tons-km) show faster growth rates than GDP, and than the material and energy throughput in the economy.

Conflicts on waste and pollution

On the "output" side, the study of social metabolism is linked to waste dumping. One example is the ship breaking yards at Alang on the Gujarat coast in India that have a devastating environmental impact. The following is a list of such conflicts.

9.- Toxic struggles. This is the name given in the U.S. to fights against risks from heavy metals, dioxins, etc. [20] **It describes also older cases in other countries, such as Minamata mercury poisoning in Kumamoto Prefecture in Japan caused by the chemical manufacturer Chisso Corporation in the 1950s and 1960s and where**

complaints continue to be put forward still today.

10.- Waste dumping. There are many conflicts around the world on waste dumps, incinerators. In an international context, "Toxic imperialism" was used by

[20] **L.M.Gibbs, *Love Canal: my Story*, State Univ. of New York Press, Albany, 1981. R. Hofrichter, ed., *Toxic Struggles: the theory and practice of Environmental Justice*, foreword by Lois Gibbs, New Society Publishers, Philadelphia, 1993.**

Greenpeace in 1988 to describe the dumping of toxic waste in poorer countries. Thus, for instance, "thousands of tonnes of electronic and electrical waste (e-waste) are being illegally exported every year from Britain to developing Asian countries, including India, Pakistan, and China" (*The Hindu*, 18 Dec. 2004. "The trade is absolutely illegal and against the spirit of the Basel Convention, said Kishore Wanhade of Toxic Link in Delhi").

11.- Transboundary pollution. Applied in the 1970s and 1980s mainly to sulfur dioxide crossing borders in Europe, and producing acid rain. Also between areas in the U.S. A. (New England polluted by western winds), and from China to Japan.

12.- Equal rights to carbon sinks. The proposal for equal per capita use of oceans, new vegetation, soils and atmosphere as sinks or temporary reservoirs for carbon dioxide[21]. The disproportionate emissions of carbon dioxide have given rise to a "carbon debt".

13.- Consumers' and citizens' safety. Struggles over the definition and the burden of uncertain risks from new technologies (nuclear, GMO, etc.) in rich or in poor countries.[22] They also affect producers (agro-toxics). Some such conflicts are new (BSE), others are decades old (asbestos, DDT, CFC...). In India, the debate on nuclear safety will perhaps grow given the large scale development of nuclear power and the plans for several fast-breeder reactors. (There is an intriguing difference between the social mistrust of breeder reactors both in Europe, where Creys-

Malville in France was closed, and in Japan, where the Monju project in Fukui Prefecture was stopped by the courts, and the public enthusiasm in India shared by the main political parties on the new Kalpakkam breeder reactor project in Tamil Nadu, inaugurated with such fanfare by the Prime Minister on 21st October 2004 that it would seem that it should become a temple of today's India).

Vocabularies of conflict

[21] **A. Agarwal and S. Narain, *Global warming: a case of environmental colonialism*, Centre for Science and Environment, Delhi, 1991.**

The different ecological conflicts can be expressed in a variety of vocabularies. Very often around the world, fights against extraction of resources deploy the language of *Indigenous environmentalism*, that it, the use of territorial rights and ethnic resistance against the external exploitation of resources. It might be that Convention 169 of ILO is used in such cases, or in India the protection of adivasi peoples in the Constitution and in the Samata vs Andhra Pradesh court sentence of 1997.[23] The language of *human rights* is used sometimes, since livelihoods might be threatened.

Or, for instance, the pattern of trade consisting in specialization in the export of raw materials has given rise to the notion of *Ecologically Unequal Exchange*. This is defined as importing products from poor countries or regions, at prices which do not take into account the exhaustion of the resources and the local externalities. *Raubwirtschaft* means plunder economy. It was used by German and French geographers one hundred years ago. Ecological dumping means selling at prices which do not take into account exhaustion of resources or externalities, "dumping" in the context of international trade means selling below cost. Ecological and economic dumping is a voluntary activity, it refers for instance to subsidized agricultural exports from U.S.A. and Europe. Instead, ecological unequal exchange arises because people in poor countries have no strength to internalize the negative externalities into the export prices, or to impose "natural capital depletion taxes". International attempts to set up "fair trade" chains for some commodities (such as coffee) may be

interpreted as signs of a growing social awareness that trade is often "unfair".

When exports of raw materials are produced by Transnational Corporations, there is often a demand for *Corporate Accountability*. This desire to make companies responsible for their socio-environmental liabilities is shown in an international context by the law suits over the last ten years under the U.S.A. legislation, ATCA (Alien Tort Claims Act), against Chevron-Texaco, Freeport

22 **These are the conflicts of Ulrich Beck, *Risk Society: Towards a new Modernity*, Sage, London, 1992.**

McMoRan, Southern Peru Copper Corporation, Dow Chemical and other companies in their country of origin, claiming damages for externalities caused in poor countries. Lack of corporate accountability is an issue that also arises in case of waste production and other types of damage, as in Bhopal from 1984 to today.[24] One of such cases has been recently settled out of court, when Unocal agreed to pay compensation in a human rights court case in California under the ATCA brought by Myanmar villagers and Earth Rights International against the oil company concerning the Yadana gas pipeline from Myanmar to Thailand. (*The Hindu*, 18 Dec. 2004).

Waste disposal, and pollution threats have given rise to the language of *Environmental racism* in the United States, meaning the disproportionate burden of pollution in areas inhabited by African Americans, Latinos, Native Americans. *Environmental Justice* is the movement against environmental racism. Uncertainties on the causes of illness have given rise to movements for *popular epidemiology*. Environmental blackmail has been used to describe situations in which either LULU (locally unacceptable land use) is finally accepted, or the local population stays without jobs. The notion of Environmental Justice is also used in South Africa, in Scotland (where poor communities are adversely affected by open cast coal mining or by waste dumps, like in Greengairs), or in Brasil.[25]

The concept of the *Ecological Debt* is used in an international context. It brings

together claims for a "carbon debt", i.e. damages from rich countries on account of past and present excessive emissions of carbon dioxide, and claims because of biopiracy, and ecologically unequal exchange or plundering of natural resources.

[23] **Samata, *Surviving a minefield. A landmark Supreme Court judgement restoring the rights of tribals*. Hyderabad, January 2003.** [24] **New cases arise all the time. For instance, Indonesian authorities are reported to plan to go ahead with a criminal law suit (in Indonesian courts) against the world's biggest gold producer, the Newmont Mining Corporation, for purposely disposing of hazardous and poisonous material into the water in Buyat Bay on Sulawesi island, damaging the health of the inhabitants. (*International Herald Tribune*, 3 Dec. 2004). Environmental and social problems in gold mining should be of interest to many Indian consumers.**

[25] **R. Bullard, *Confronting environmental racism: voices from the grassroots*, South End Press, Boston, 1993. P. Bond, *Unsustainable South Africa*, Merlin Press, London, 2002. K. Dunion, *Troublemakers: the struggle for environmental justice in Scotland*, Edinburgh U.P., Edinburgh, 2003. H. Acselrad, S. Herculano and J.A. Padua, eds., *Justiça Ambiental e Cidadania*, Relume Dumará, Rio de Janeiro, 2004.**

Another term used in the context of international inequalities is that of *Environmental space* meaning the geographical space really occupied by an economy, taking into account imports of natural resources and disposal of emissions. *Ecological footprint* is a similar notion, i.e. the carrying capacity appropriated by large cities or countries measured in terms of space. (As remarked above, the *ecological footprint* adds up food and other biomass, plus fossil fuels, plus the built environment, translating everything into space). [26]

Finally, the opposition between *Ecological trespassers* and *Ecosystem peoples* signals the contrast between people living from their own resources, and people living from the resources of other territories and peoples. [27]

The study of ecological conflicts makes visible the environmental contents in social conflicts which were "disguised" under different headings. For instance, *workers' actions for occupational health and safety* are and have been struggles (in the framework of collective bargaining or outside it) to prevent damages to workers in mines, plantations or factories (they are, so to speak, "red" outside, and "green" inside). Also, *urban activism for clean air and water, green spaces, cyclists and pedestrian rights* has inspired old or new struggles outside the market in order to

improve environmental conditions of livelihood or to gain access to recreational amenities in urban contexts. Such actions have been expressions of ecological distribution conflicts even though the actors (and their analysts) perhaps did not yet use an explicitly environmental vocabulary.

Ecological distribution conflicts might also give rise to what has been called *Social ecofeminism,* or *Environmental feminism*[28], meaning the environmental activism of

26 **M. Wackernagel and W. Rees, *Our Ecological Footprint,* New Society Publishers, Philadelphia, 1995.**

The idea comes from Dasman, it was applied to India by M. Gadgil and R. Guha, *Ecology and Equity: The Use and Abuse of Nature in Contemporary India,* Routledge, London, 1995, distinguishing between three categories of people: "omnivorous", "ecosystem peoples" and "ecological refugees".

women, motivated by their social situation. The idiom of such struggles is not necessarily that of feminism and/or environmentalism.

Finally, the *Environmentalism of the Poor* describes social conflicts with an ecological content, today and in history, of the poor against the relatively rich, not only but mainly in rural contexts.[29]

Local and global

Some ecological conflicts in this list are local, and some are global. Some are fought in an explicitly environmental language, and some in other languages. One thing is clear - there are close connections between local conflicts and global environmentalism. Thus, the movements for the defence of mangroves in the Pacific Coast of Central and South America have pointed out to the role of mangroves as first coastline defence, increasingly important confronted with recurrent Niños plus the risk of greenhouse sea level rise. Local resistance movements reinforce the global networks, and in turn they profit sometimes by adding the language and the strength of global

environmentalism to their own local idioms and forms of resistance. At other times, the conflict arises in the first instance because of the external global influence - witness the recent use of the language of biopiracy in conflicts over property rights on *uña de gato, ayahuasca, sangre de drago, jacarandí, quinua,* and also basmati rice, neem, turmeric, in several Latin American countries and in India.

Links are developing between local and global aspects of the disproportionate use of carbon sinks by rich people. For instance, Oilwatch groups around the world complain against local impacts, but they also point out that more oil extraction means more carbon dioxide production, and that a moratorium on oil extraction in fragile areas (tropical rainforests, mangroves) would make a global contribution against climate change. This network born from local conflicts between oil

[28] **B. Agarwal, The Gender and Environment Debate: Lessons from India, *Feminist Studies*, 18(1), 1992.**

[29] **As explained in Ramachandra Guha, *The Unquiet Woods: Ecological Change and Peasant Resistance in the Himalaya,* Oxford U. P., Delhi, 1989, and in R. Guha and J. Martinez-Alier, *Varieties of Environmentalism*, Oxford U.P., Delhi, 1998.**

companies and local populations has then learnt to use "greenhouse" arguments against oil extraction.

The defence of indigenous groups against the oil or mining industries, or against large dams or logging, could be seen as part of a politics of identity, while the Environmental Justice movement in the United States insofar as it fights against "environmental racism", could also be seen in this light. However, the connections between local and global issues are obvious to the actors themselves. There exist international networks which grow out of local conflicts and which support them. Moreover, there are cross-cultural similarities in resistance movements. For instance, we find in distant places the same collective actions against shrimp farming that consist in making a hole in the dyke of a pond or raising the shutters, and then replanting the mangroves once the water and the shrimp crop flows out. Or in the fights against the private appropriation of common property lands, the eucalyptus or

other undesired plantation trees are pulled out, and other trees are put it. Therefore, to see ecological distribution conflicts as a manifestation of the politics of identity would not be convincing. It is rather the other way around, the politics of identity being one of the idioms in which ecological distribution conflicts are expressed.

The relations between Political Economy and Ecological Economics

Ecological distribution conflicts arise because of the fact that economic growth, and population growth, lead towards increased use of materials and energy, and therefore towards larger production of waste. Because of unequal property rights, and social inequalities of power and income among humans (both international and internal to each state), the burdens of pollution and the access to natural resources are unequally distributed.

Ecological Economics studies the relations between the economy and the use of material and energy, in a socio-metabolic perspective. In order to do so, analysts resort to many indicators. We might summarize them into Material and Energy Flows, and the Human Appropriation of Net Primary Production (HANPP). So, if the economy was becoming "dematerialized" in an absolute sense (and not only, as in some countries, relative to GDP), then many of the conflicts listed above would become less pervasive and intense. One instance of the link between indicators and conflicts: the appropriation of all the biomass of mangroves by the shrimp industry gives rise to social and environmental conflicts. This is also sometimes the case with the appropriation of the biomass in tree plantations for export as paper pulp. Thus, we could trace the relations between the Metabolic Profiles of different countries (and regions) and the environmental conflicts that arise.

Ecological Economics is relevant for Political Ecology in a second way, namely, the conflicts regarding the use of the environment may be expressed in different languages of valuation. For instance, some actors might say that destruction of a

mangrove or pollution of a river is after all an "externality" which can be made good and compensated by the economic value established in a fictitious market. Other actors will perhaps refuse such chrematistic language, and will appeal instead to the livelihood and rights of local peoples, or to the sacredness of nature, or to ecological and landscape values, or to the equal dignity of all humans when confronted by "environmental racism". Who has the power to simplify complexity by imposing a single language of valuation? An Ecological Economics which is not money-reductionist but is open instead to value pluralism (perhaps operationalized through multi-criteria evaluation) will therefore will able to cooperate with Political Ecology in the analysis of ecological distribution conflicts.

Finally, there is still a third point of encounter between Ecological Economics and Political Ecology. The outcomes of such conflicts are important for the pattern of prices in the economy. Movements for "environmental justice" may become a strong force for sustainability. On the contrary, if claims for environmental justice are almost never successful, then a potential force for sustainability is being repressed and wasted.