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Are Cities Parasites or Resource Pools?

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Cities consume and transform massive flows of energy and matter. How can their "metabolism" contribute to their sustainability? Addressing the issue of resources and waste in urban areas, Sabine Barles discusses the contradictions of urban self-sufficiency. Exploring means to control resources in an endogenous development perspective, she sketches the transition to a less matter-consuming society.

Does sustainability imply urban self-sufficiency? And if so, is such a goal possible? This twofold question will be addressed here through the prism of territorial ecology and urban metabolism. It might as well be stated right away: the answer to both questions will be no – at least if we take urban self-sufficiency in the strict sense. However, this does not mean that the debate about urban self-sufficiency is pointless.

The approach suggested here aims at understanding how cities consume and transform energy and matter, and how, by making use of these, they summon and modify the resources of the biosphere. Urban metabolism – with all the caution that this organicist analogy requires – helps us characterize the interactions between society and nature. How much energy does a city need to carry out all of its activities? How much matter: water, food, finished products, and so on? What happens to these flows after they have come into the urban society and have been used and transformed? In what form do they eventually go back into nature? With what consequences? For its part, territorial ecology aims to put urban metabolism into a spatial and social framework. The flows of matter and energy put into play by a city result from political, economic, social and technological choices; they reflect not just the normal processes of the biosphere but also the functioning of society, and they cannot be analysed without taking that into account. These flows connect urban spaces to other territories, which supply them or

receive their excreta, so the environmental imprint of any given city can far exceed its boundaries.

Unsustainable Cities?

With regard to both energy and material, contemporary cities appear to be unsustainable, for two important reasons: the very high pressure that they place on natural resources, and the large amount of various kinds of emissions that they generate. Although generally considered separately and independently, these reasons are in fact two sides of the same coin: cities consume large quantities of matter and energy, which they then return to nature in diverse forms – solid waste, wastewater, and air emissions. So they contribute not only to the intensity of material flows, i.e. to the increase of the amount of matter put into circulation by drawing on natural resources, but also to its linearization, since after it has been consumed, matter is rarely put back in the place it was taken from, or when it is, it is in a form not very compatible with that place.

Linearization and intensification of material flows explain the basics of the various environmental problems that confront us today: the exhaustion of resources, the degradation of ecosystems and of the conditions of urban life, and climate change. They translate into a disruption of biogeochemical cycles[1] (which are therefore no longer complete) and an environmental dysfunctioning arising either from the upstream exhaustion of a resource or from the downstream accumulation of matter produced, or from both. For example, the use of fossil fuels translates into extracting large quantities of carbon from the bowels of the earth (in the form of coal or hydrocarbons), which after combustion ends up in the atmosphere, causing an accumulation of this element, with well-known consequences in terms of climate change. In the same way, part of the nitrogen extracted from the air for the production of fertilizer ends up in water and soil, causing a deficit of oxygen and/or an excess of nitrates. Heavy metals extracted from the earth are also scattered through different parts of the environment, contaminating water, land, air, and the food chain. One could multiply such examples. The role of cities in these processes is fundamental, given the size of their population (more than half of the planet's, close to four fifths in the case of France).

[1] Biogeochemical cycles are processes of the transformation and movement of elements or of chemical compounds among land, water and air.

The Contradictions of Urban Self-sufficiency

Seen in this perspective, the idea of urban self-sufficiency obviously contains some basic contradictions. In fact, for a city to be self-sufficient it would have to draw all of its needed resources from its own territory, and these resources would have to be as renewable as possible; it would also have to manage its excreta in a way that would complete biogeochemical cycles locally. However, a renewable resource is often a surface resource, i.e. its production is directly related to the surface area that is devoted to it. In fact, resources that are called renewable are limited by the capacity of the biosphere to produce them (thus they are not inexhaustible), and in most cases this capacity depends on solar radiation, which in the end is limited by the relevant surface area. This can be seen, for example, in the case of agricultural production (and sustainability leads to the promotion of reasoned or organic farming, thus to lower yields than those of industrial farming), or in the case of biofuels that undergo photosynthesis, or directly in the production of solar energy. This is the first obstacle to self-sufficiency: it would require a huge area (relative to the area taken up by urban spaces), which to some extent contradicts the very idea of a city.[2]

This partial contradiction may be outdated if physical proximity is no longer taken to be the *sine qua non* of social or economic proximity – which explains why it is increasingly obsolete to base the definition of a city on the continuity of construction. Nevertheless, experience shows that in spite of the development of telecommunications technology, physical meetings are often necessary for exchanges between persons, whatever the reason for the exchange; besides, material things have to be transported from one place to another in order to reach their recipient. So a city that would be extensive enough to produce its own resources would be a site of long-distance movements, contrary to what is expected in an energy-efficient city. In addition, this self-sufficient city would also need to have the workforce and the facilities necessary to exploit these resources, which is inconsistent with the idea of the city as a place of exchange more than of production.

These arguments provide some answers to the second part of the original question: there is an inherent contradiction between the city and self-sufficiency. For this reason, during

[2] Paul Waggoner has done some calculations that illustrate this very well – although I do not share his conclusions. P. E. Waggoner, "How can EcoCity get its food?", *Technology in Society* 28, 2006, pp. 183-193.

the second half of the twentieth century, ecologists (starting with Eugene Odum[3]) classified cities as heterotrophic systems,[4] or even as parasitic ecosystems, since they are completely dependent on the exterior for their supplies and for the management of their excreta. Pursuing this line, urban ecology's denunciation of the harmful nature of cities has continued,[5] and has probably hindered the identification of their potential contribution to sustainable development in its environmental dimension.

Can Cities Become Linchpins of Self-sufficiency?

So how can urban metabolism be more consistent with the goals of sustainable development? One line of thinking is to stop considering cities as unbearable parasites, to see them instead as valuable pools of energy and material resources, and to measure the contribution of the development of these resources to societies that consume less matter. The management of excreta is currently based on the use of inefficient end-of-pipe technology.[6] As an example: for all of its activities today, counting all materials (except water), the central Paris area (the commune of Paris plus its suburbs in the three adjacent departments) consumes 11 tons per person per year, and it discharges more than half of this: 6 tons per person per year in solids, liquids and gases. We need to identify among these latter those that could become not waste but raw materials[7] the recovery of which would let us decrease not only waste but also the pressure on resources. The net consumption of construction materials is 2.6 tons per person per year in the Île-de-France region (Paris plus the seven nearest departments), which imports 1.5 tons of these materials from neighbouring regions and discharges the same amount each year. In absolute terms, recycling[8] would enable not just the suppression of discharges with their procession of nuisances, but also reducing imports and their environmental consequences, such as the multiplication of quarries and the emissions

[3] E. P. Odum, *Ecology: The Link between the Natural and the Social Sciences*, 2nd ed., New York: Holt, Reinhart & Winston, 1975; Odum, *Ecology and Our Endangered Life-support Systems*, Sunderland, Sinauer Associates, Inc., 1989.

[4] Strictly speaking, a heterotrophic organism feeds on organic substances which it cannot synthesize.

[5] In this case, "urban ecology" is ecology of the city rather than ecology in the city.

[6] Very well illustrated by wastewater management, particularly in the twentieth century. Health imperatives led to it being collected in a sewer system flowing into the aquatic environment. This solves the public health problem, but results in the degradation of water resources and difficulty in urban water supplies. So a water treatment plant is built, the quality of the resource is improved, but a by-product is generated: sewage sludge. Its quality makes it risky to spread, so a sludge treatment plant is added. The air emissions from the treatment of the water and the sludge are nuisances, so the gaseous wastes are also treated. In the end, we have multiplied the facilities – each time producing new by-products and negative externalities – and increased the cost of treatment, often for poor results (in particular, low purification yields).

[7] Given that recycling is currently less than 1 ton per person per year, in addition to the 6 tons per person per year mentioned above.

[8] Obviously it cannot be total.

from long-distance transportation. That would be a real contribution to lowering the consumption of materials, since recycling would make it possible to avoid extracting new materials.

This example comes close to the idea of self-sufficiency, since it is a case of destroying the city in order to construct the city; but it is clear that recycling is not enough. It is also necessary to consume less, whether of new or of recovered materials. Following through the example of construction materials in the Île-de-France region, we can see that even a total recycling would not completely spare the resource, for a closer analysis shows that their consumption is due essentially to the four outer departments in the region, where construction is not much greater than in the rest of the region, but where diffuse urbanization entails infrastructure needs (roads, networks, diverse facilities) that significantly enlarge the consumption of construction materials. Consuming less matter also means thinking about urbanization – as we already know is the case with energy – and therefore also has implications for lifestyles.[9]

Moreover, generalizing this approach implies reassessing possible synergies between cities, industry and agriculture. In the nineteenth century, cities were considered as sources of fertilizer and there were battles to recover the "matters that cities must account for to the land" [10] – human and animal urine and excrement, butchers' by-products, street mud, oyster shells, woollen rags, old shoes; at the same time, from cloth with vegetable origins came paper, from waste paper came cardboard, from food tins came toys, and from bones came animal charcoal: all matters that today have become wastes and contribute to the degradation of ecosystems. In fact, a more sustainable management of the flows of energy and matter is hampered by the complexity and the current compartmentalization of the potential stakeholders. Those who supply the cities are not those who manage the cities' excreta, and neither generally knows anything about the other, to such an extent that there really is no governance of the flows; discovering the practical means of such governance is one of the major issues of sustainable development. The difficulty here is reinforced by the lack of coincidence between the area supplying a city – generally very large and fragmented, international if not planetary – and its area of emissions – more concentrated, regional in the

[9] On this subject, see M. Dobré, S. Juan (eds.), *Consommer autrement: la réforme écologique des modes de vie*, Paris, L'Harmattan ("Sociologie et environnement" collection), 2009.
[10] J. B. Dumas, "Rapport conclusif" (half title), in Commission des engrais, *Enquête sur les engrais industriels*, Paris, vol. 2, 1866, p. xxxi.

case of Paris. So the secondary raw materials that the city might supply are far from the industries that could use them, thus lowering the incentives to do so: linking production and consumption is not just a matter of transportation.

Finally, reflection on the city and its consumption of energy and matter should not be limited to the urban area. The production of the matter and energy that cities concentrate requires many more resources than are finally contained in the products that the cities import, and also generates the production of large quantities of waste. These indirect flows – these environmental imprints – cannot be disregarded. Being consumers of these products gives cities a very powerful means of influencing what happens elsewhere. Still, they must want and be able to make use of these means. Thus, while the issue of self-sufficiency is essential to the perspective of sustainable development, it must be examined in more than just the urban dimension, systematically analysing the relations that cities have with the territories on which they depend and which depend on them.

First published in laviedesidees.fr. Translated from French by **John Zvesper** with the support of the Foundation Maison des Sciences de l'Homme.

Article published in Books and Ideas, 18 April 2011.