

ECOTOPIA, TOWARDS AN ECO-SOCIO-MORPHOLOGY

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This paper presents a urban design project of insertion of a restoration system into the city to accelerate recycling and regeneration of the system. This restoration system consists of a series of eco-machines which are not isolated from each other but are making up an “eco-tribe”, that could rehabilitate the urban ecosystem with eco-technologies and eventually could be integrated into the urban environment.

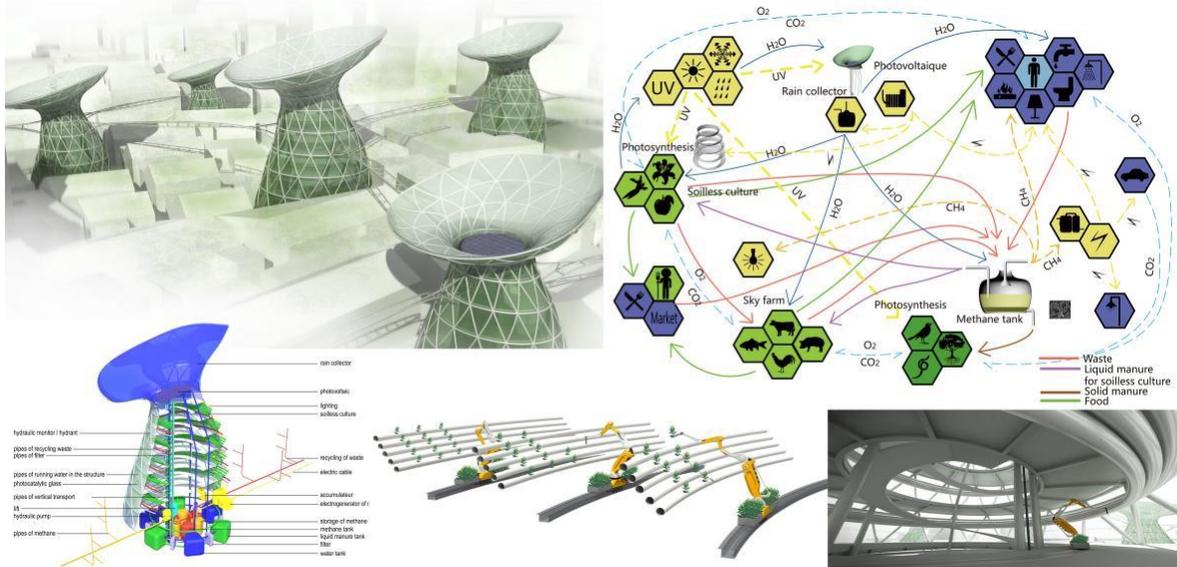


Fig 1. ECOTOPIA, 2008, digital image, Copyright Bin JIANG.

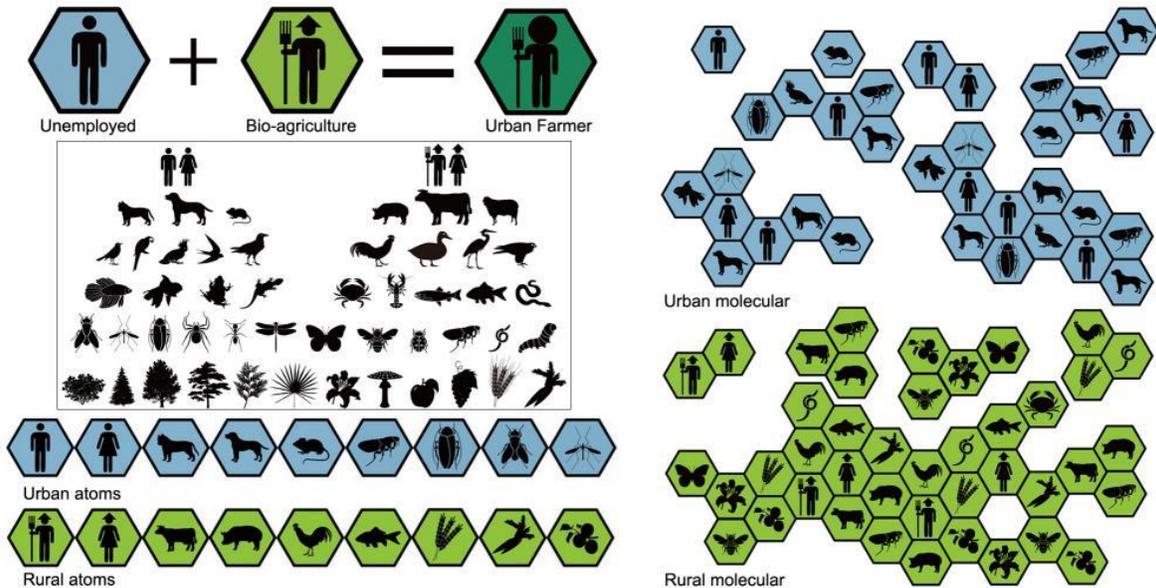


Fig 2. Semiotic system of ECOTOPIA, 2008, digital image, Copyright Bin JIANG.

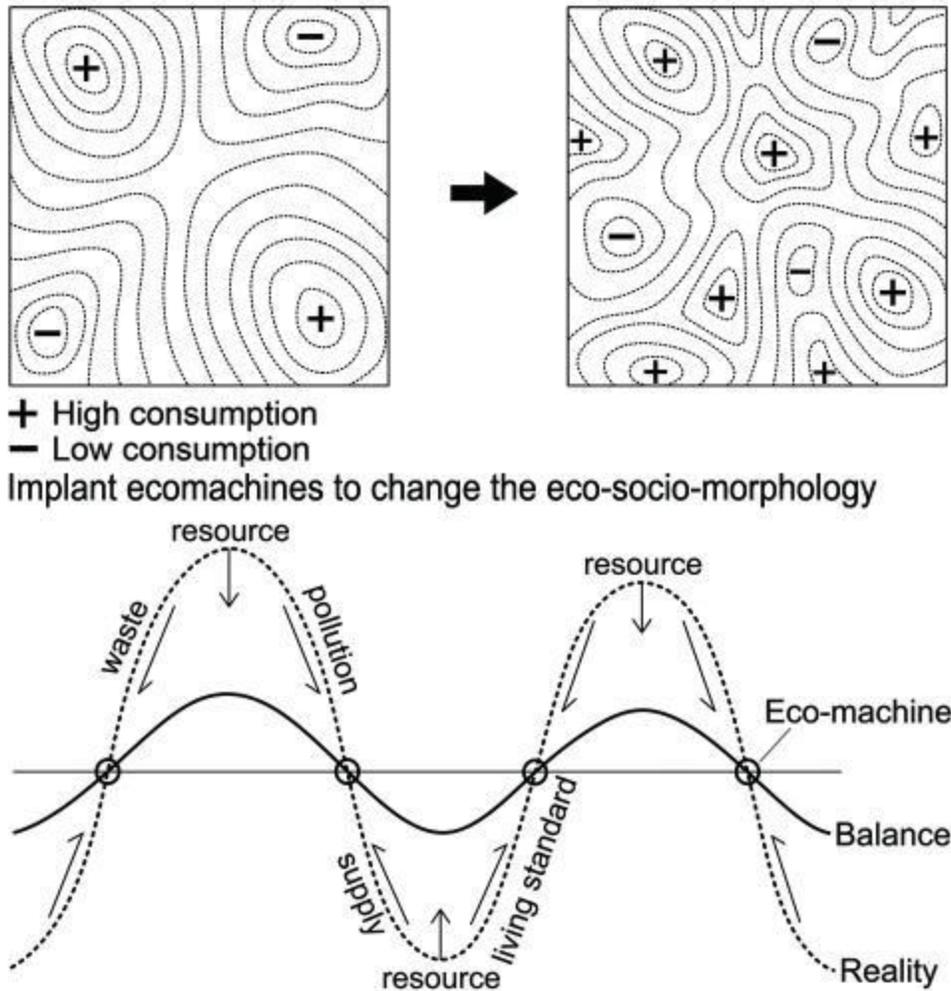


Fig 3. *Implant ecomachines to change the eco-socio-morphology*, 2011, Copyright Bin JIANG.

Today the ecosystem is suffering serious damages, due to the unbalanced state provoked by human intervention. This is the starting assumption of this paper.

We are first going to illustrate the ECOTOPIA project proposed by Bin JIANG in 2008. [1] The idea of this project is to insert a restoration system of eco-technologies in the interior of the city, where the living environment is deteriorating, in an attempt to accelerate the system's recycling and regeneration. This restoration system has been proposed together with a semiotic system, interpreting the relationship of various representative organisms in the urban, rural and wild environment. We will present the functions and the advantages that such a system should possess.

Secondly, in order to question and develop this proposition, we are going to formulate the working-hypothesis that the restoration system could be seen as a network of dynamical perturbations injected at a certain scale into the city, intervention that could modify the ecosystem of the city as a whole. We will develop this idea on the basis of a structural – although dynamical - interpretation of the metaphor of landscape, coming from theoretical biology. Without taking into account the semantic connotations that could be associated to this metaphor, in the context of theoretical biology. We consider looking at the initial ECOTOPIA project, structural and morphological properties of landscapes.

The Gaia hypothesis, [2] a theory announced by James Lovelock in 1969, but also exposed by Johannes Kepler in the 17th century, alleged that living organisms on our planet worked according to certain self-recycling rules which can satisfy their own needs within a gigantic organism called Gaia (named after Gaia, Greek goddess of the Earth). Two centuries later in 1924, this theory got backed by the concept of "biosphere" [3] raised by Viadimir Vernadsky who had also realized for the first time the undeniable connection between deforestation and climate.

The natural ecosystem possesses certain self-restoration abilities and this kind of restoration needs a certain period of time. The traditional agricultural production is based on cycle of nature and natural resource processing, which is a mode of production conforming to the nature's rules. On the contrary, we have entered into the industrial era which is developing at fast pace. Under such circumstances, the pressing production cycle does not allow the necessary duration for the nature to restore itself, which means that the producing capacity of the industrial society has gone far beyond what the nature can bear. In the long run, the serious ecosystem imbalance is inevitable.

The industrial production can devour natural resources of huge volumes in a short period of time and furthermore, it can change chemical structures or biological genetic structures of natural materials. As a result, the nature is also overwhelmed to achieve the self-restoration in time. Though some damages are irreversible, at least during one generation, the project of inserting urban ecosystem into the global natural ecosystem as a part of industries, could make a change. The industrial society and the environmental pollution actually coexists with each other inseparably. Without any doubt, the problem of pollution arises along with the rapid development of industry.

The ECOTOPIA projet intends to insert a restoration system into the high density city. The leading idea of this project is that the eco-architectures forming the restoration system should be curative, intervening as living machines. They should be inserted into cities and be interdependent with each other, in order to develop sustainably, as in a transplant of new artificial organs to a withering ill body. [fig1]

The idea is to bring the eco-agriculture into the city as a treatment measure, in another words, to insert the eco-agricultural system into the urban ecosystem as a restoration therapy in order to cure the industrial society by the agricultural production.

This restoration system consists of a series of eco-machines which are not isolated from each other but are making up an "eco-tribe". This could rehabilitate the urban ecosystem with eco-technologies and eventually could be integrated into the urban environment. The organized restoration system is a breakthrough from the existing patterns of the community, simulating the operation of natural ecosystems, will be inserted into the wrecked urban ecosystem and connect all communities to take effect in the range of the whole city. With self-reproduction and duplication, the system could constantly grow and evolve along with the city's development and technology innovations.

Le Corbusier said: "The architecture bears living organisms. They present to the space, the light, ramify themselves and extend as a tree or a plant. The freedom is researched around each part." [4] My design concept for the eco-architectures is derived from the sea anemone structure. The unit of the system is a kind of recycling tree tower, called "Sky farm", which seems like a stretching sea anemone facing towards the sun. It will be inserted into the existing communities. In the high density city, it is difficult to find much available ground space; therefore, I choose to develop the agricultural cultivation in the vertical space. Each tower, at a certain distance from others, is connected by an overpass in the sky which exchanges energy and materials. Several tree towers form an Eco-tribe whose unit is community. In this

way, these implanted eco-agricultural machines not only could resolve many environmental problems such as reducing the emission of CO₂ and other harmful gases, eliminating organic waste, supplying clean water sources and energy, but could also satisfy food demand of community residents directly. As a result, these eco-tribes and local communities could make up a brand new harmonious and efficient eco-community without pollution.

A semiotic system interpret the relationship and composition of various representative organisms in the urban, rural and wild environment, is introduced. In order to present this semiotic system, some definitions will be useful. [fig2]

Natural Ecosystem: The biosphere is a kind of global self-sustained ecosystem. It integrates all the living organisms through various biological chains and classifies them into 3 categories: the lithosphere, the hydrosphere and the atmosphere. All of nature's movements alter the appearance of our planet by ceaseless circulation and recombination of elements.

Urban Ecosystem: The human activities have been changing the earth's appearance. Cities have come into being along with the concentration of population. In the same way, other living beings in cities have gradually altered themselves to adapt to the urban living environment. The urban ecosystem exists as an artificial link in the whole natural ecosystem and has the great impact on the latter one.

Rural Ecosystem: The rural area is a buffer zone between the natural and the urban ecosystems.

In the semiotic system introduced together with our eco-architectures, different organisms are symbolized by a representative atom. In the urban environment, residents, domestic animals and other smaller parasites relate with each other, building up an urban molecular chain. These chains combine together, engendering more complicated and gigantic compounds among which the biggest one is the social system. As for in rural environment, peasant is the basic atom, along with farm animals and agricultural plants, composing the rural molecular chains and their compounds. While in the wild natural environment, the basic unit is trees, which constitute the natural ecosystem with other wild animals, plants and insects.

On the basis of this semiotic system, some more general 'equations' can be imagined, that should define and produce the constitution of the Eco-city:

- Architect = Organizer of the production
- Architecture + Eco-technique = Eco-machine
- (Eco-machine + Bio-agriculture + Urban farmer) x n = Eco-tribe
- Eco-tribe + Existing Community = Eco-community
- Eco-community x n + Eco-system = Eco-city

The constitution of the Eco-city should perform the following functions:

1. Developing the urban eco-agriculture and restoring the urban ecosystem .
2. Initiating the system operation with the solar power in the early stage, and then maintaining the system and the supply for communities by bioelectricity: first, recycling sewage and organic waste produced from daily life and agricultural production; using the waste liquid from the methane reactor as the nutrition of soilless cultivation and livestock feed, while the waste

residues as fertilizer of public green space; generating electricity with the clean methane to meet the needs of household fuel gas, public illumination, power supply for the electricity bus and so on.

3. Sky farm: introducing the bio-agriculture, soilless cultivation, livestock breeding in a vertical space, perfecting the urban biological chain and supplying predominant food.
4. Lighting of the farm: the loop bracket of soilless cultivation turns around driven by electricity, like a revolving restaurant, in order to let all crops receive light evenly by adjusting the way of revolving and its speed according to seasons and time.
5. Tree towers with water line in them constitute a group of fire control towers in the high-density community, ready to alarm and fire-fight any time; possible to spray water directly from the tower to the house on fire or draw the fire-fighting lance to put out the fire.

The fact of transplanting countrysides in the city should provoke a restructuration of the society frame. The eco-community alters the former concepts of community, unifying the traditionally separated communities and promoting the trans-community exchanges. In addition, insertion of the eco-agriculture into the city will result in a new social type called "Urban farmer". Thanks to the leverage effect of eco-technologies, fewer farmers could provide more products, compared to the traditional agricultural production. Furthermore, the urban farmer also shoulders the responsibility of maintaining the virtuous circle of urban ecosystem.

On the other hand, the popularization of urban eco-agriculture, as a vivid textbook, would facilitate those who grow up in the city to approach the nature and comprehend the movement of natural ecosystem, thus make them realize the importance of protecting the nature and restoring the urban ecosystem to intensify their sense of belonging to the nature.

How do these desiderata can be realized? Are these 'equations' producing the emergence of new, balanced, equilibria? We think that the design of such an eco-city should comprise an analysis of the balances of the different, unstable equilibria in town. How to we switch from the point of view of the designed objects and their functionalities (expressed by the 'equations') to the point of view of the resulting equilibria in town? We follow here a line that takes into account some aspects of the figure of landscapes in theoretical biology, discussed in the framework of the Dynlan-Dynamic Landscapes research program. [5] In our research program, we are interested in the structural, although dynamic properties of landscapes. Thus, even whether we refer to images coming from the history and the theory of contemporary biology, we do not consider the semantic connotation of these figures in their original contexts. We consider them as structural dynamic images that can help in asking questions and setting scenarios. We are encouraged on this way by the structural and holistic attitude that moved Conrad Hal Waddington in the introduction and heuristic use of his image of epigenetic landscape. [6] For example, Waddington could introduce the notion of genetic assimilation on the basis of both of his experimental work and of the potentialities of landscapes images. Of course, even in our case, this work of abstraction is a first step of the research, and should be accompanied by empirical, situated, studies.

With the help of the hilly surfaces of landscape images, we want to move our discussion from the plan of the project ECOTOPIA in the actual space of the designed objects, the space of the city, to the plan in which the different equilibria. In order to grasp this second plan, we consider a metaphorical phase space. [fig3]

Could the global morphology of landscape, representing the global equilibria portrait, be affected by an external perturbation? How could one alter landscape equilibria, especially if they define too important

discrepancies between different consumption regimes? The idea is that the introduction of eco-machines as perturbations could modify the socio-eco-morphology of the landscape.

Inspired by the well-known image of Sewall Wright landscape, [7] here the idea is that the hills of the landscape should represent picks of higher or lesser consumption, a quantity that is both a socio and ecological indicator. How external, cyclic, autonomous but interconnected interventions could modify the global form of the landscape?

We use the landscape metaphor, as a heuristic tool, a mental image to help in reasoning. We are trying and look for balance processes in phase space as an approach to conceive an urban system able to actually produce these equilibria. In order to come back to the empiric world, with this hypothesis and questions in mind, and to evaluate the pertinence and the fruitfulness of this approach, at this step of our research we are exploring the field of studies from the territorialist school, [8] to the field of sustainable change researchs for example Babalis. [9] But we are also interested in the approaches that look at the town as a complex system and propose mathematical models and simulations. [10]

Eco-socio morphodynamics produces a modification of the landscape profil. In conclusion, we assume that the post-industrial society would completely enter into a new era of intelligence in decades when green technologies would become prevalent and the eco-agriculture would accomplish totally automatic and efficient production. Furthermore, the urban eco-community would be duplicated and extended constantly to maintain the urban ecology and the natural balance. In particular, the whole ecosystem could come into the virtuous circle.

A structural use of the landscape metaphor, suggests that morphological and morphodynamical aspects of the echo-city could be studied in the phase space, as a global approach to equilibria and changes in equilibria. However, in order to cope with complexity of eco-social system, we think that moving from the traditional hilly surface representing a landscape, to more plastic, morphologically variable objects, could help our future reflection.

References and Notes:

1. Bin JIANG, "ECOTOPIA Project," in *Self Sufficient City*, ed. Lucas Cappelli and Vicente Gualart, 180-183 (Spain: Institut for Advanced Architecture of Catalonia, Actar Press, 2010) and "ECOTOPIA Theory," paper presented at ISEA2011 Conference (Istanbul, 2011).
2. Lovelock James, *Gaia: A New Look at Life on Earth* (New York: Oxford University Press, 2000 [originally 1979]).
3. Vernadsky Vladimir, *The Biosphere* (Berlin: Springer Press, 1986).
4. Le Corbusier, *L'espace indicible* (Paris: Fondation Le Corbusier, 1945), 210.
5. S. Franceschelli, "Dynamics of the unseen: Surfaces and their environments as dynamic landscapes," *Proceedings of GA2009, XII Generative Art International Conference*, (2009): 236-247 and "Dynamic landscapes," paper presented at ISEA2011 Conference (Istanbul, 2011)
6. C. H. Waddington, *The strategy of the genes* (London: Allen and Unwin, 1957).
7. S. Wright, "The Role of Mutation, Inbreeding, Crossbreeding, and Selection in Evolution," in *Proceedings of the Sixth International Congress of Genetics*, t. 1 (1932), 352-66.
8. Magnaghi Alberto, *Il progetto locale* (Bollati Boringhieri, 2000).
9. Babalis Dimitra, ed., *Chronocity: The Scale of Sustainable Change. Heritage value and future opportunities and challenges* (Firenze: Alinea Editrice International, 2008).
10. Batty Michael, *Cities and Complexity: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals* (Cambridge, MA: The MIT Press, 2005).