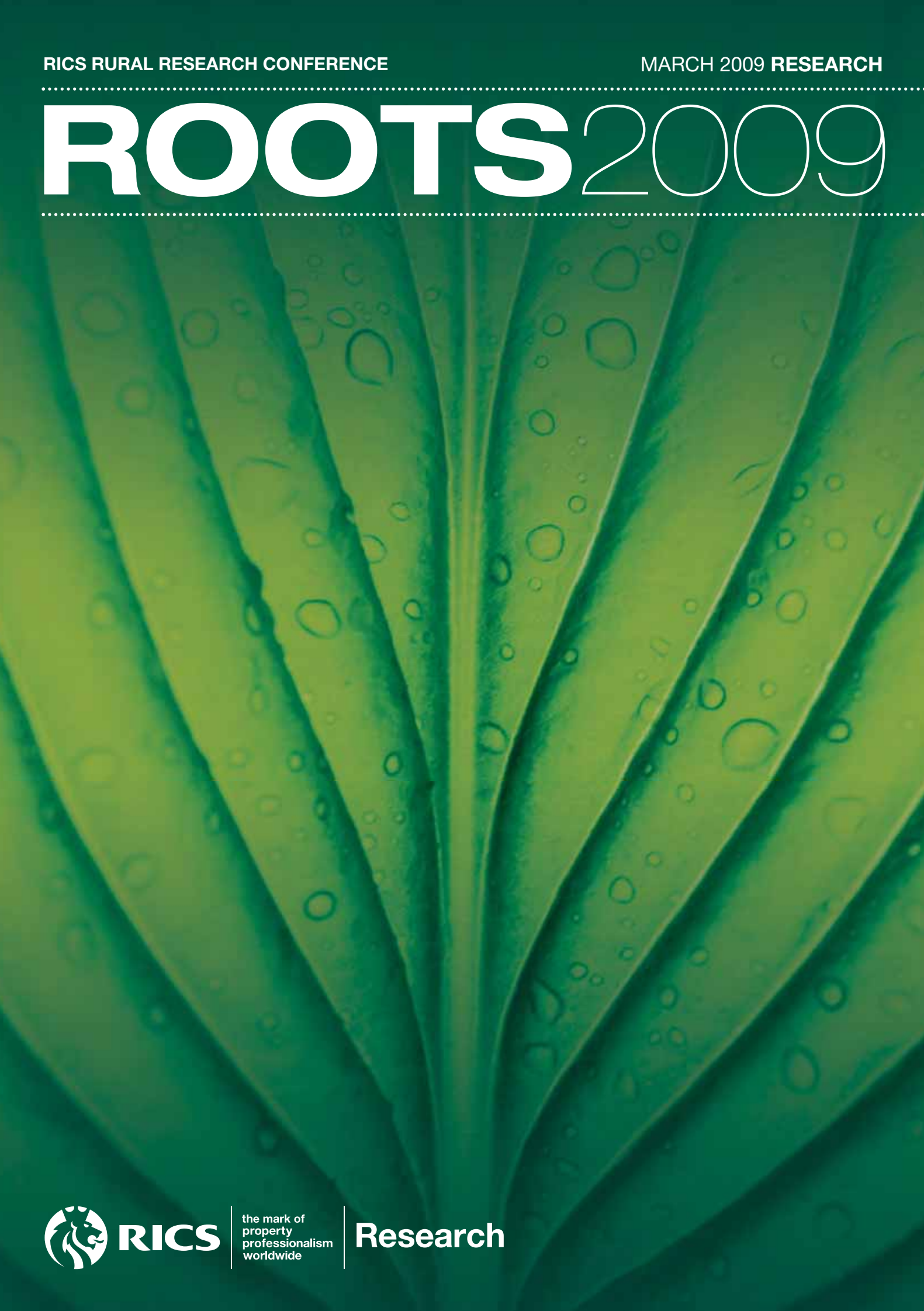
Create new local sustainable networks by using the “Systemic Software input/output”

RICS RURAL RESEARCH CONFERENCE

MARCH 2009 **RESEARCH**

# ROOTS2009



RICS

the mark of property professionalism worldwide

Research

Published by:

RICS
Parliament Square
London SW1P 3AD



ISBN 978-1-84219-597-0

# Create new local sustainable networks by using the “Systemic Software input/output”

Clara Ceppa
Disegno Industriale, Politecnico di Torino, Turin, Italy
clara.ceppa@polito.it

**Abstract**

The research, in collaboration with Neosidea Group, is about the proposal of an instrument for analysis based on the concept of an open system that would allow the configuration and realization of networks of connections among different companies in geographic proximity, to achieve zero emission by implementing a sustainable management of their wastes.

The goal is to design a system for processing information, that can organize data relative to output (waste), input (resources) and local companies.

The processing system was also supplemented with the function of geo-locating business is and materials and this provides a solution and that gives not only information regarding new areas of application of the outputs but also determines with precision and localizes by territory the flows of material within a local network whose nodes are represented by the companies present on that territory; this promotes the local businesses and evaluates market opportunities of areas currently not yet exploited according to the systemic approach.

Until now the area of application was the territory of the Piedmont Region.

The advantages of such an approach are environmental and economic; it’s possible to reduce the cost of eliminating waste, increase the profits from selling the company's outputs, reducing environmental costs (air-pollution caused by the transportation of materials); the use of already existing materials in loco removes the need to exploit virgin raw materials.

The functions of the software are:

- producer of waste can determine which local companies could use its output as input, or find out which companies produce the outputs that it needs as resources;
- it is an effective instrument for evaluating the entire production process, and also becomes a means for obtaining feedback: if the software doesn’t give any results, it means that there are some problems in the process or in the input used.

***Keywords****: Software, sustainable local networks, Systems Design, sustainable rural development, output-input, autopoietic system, reuse of waste, new local flows of materials, sustainable local production, open production system.*

## 1. Introduction

Throughout its development the human race has acquired capacity to gather, process and metabolize information for the purpose of manipulating the environment to its own advantage. However it is now common knowledge that this type of exploitation has reached levels that are causing severe ecological problems to the entire ecosystem, such as the gradual extinction of species or local populations, the impoverishment of natural resources, the inconsiderate use of energy sources and the progressive cessation of traditional productive activities (Chelazzi, 2004) due to a preferences for more "globalized" ones. In this situation it becomes essential to develop efficacious systems and models that allow us to evaluate in economic terms and, more importantly, environmental terms, and the incidence of continuous human interventions on the biotic and abiotic components of any given ecosystem. This is referred to by botanist Tansley as “an integrated system, the place where energy and material cycles flow to and from”. According to Chelazzi’s concept, more rational ways for procuring natural resources are possible if we can learn to combine and satisfy three types of needs: economic, aimed at the maximization of profit, bio-economic to maximize long-term biomass production, and lastly, ecological to conserve biodiversity. These three goals are not necessarily in competition with each other. New procurement modalities based on biology and the study of population evolution make it possible to use give-and-take solutions that meet these various needs.

If, on the one hand, we are witnessing an irrational exportation of natural and energy resources, on the other hand the mass media bringing to our attention another serious problem: the exponential increase in waste from the productive sector, whether industrial or agrifood. All transformation activities produce waste materials and pollutants but some also contaminate the natural elements by putting finished products on the market (Frey, 1995) that are potentially harmful due to their physical-chemical characteristics. This is the case of fertilizers, pesticides and detergents. In other cases they reduce the lifecycle of the product itself and this in turn causes a sharp increase in waste and the consumption of resources. Only by observing the internal dynamics of Nature as a system, where the concept of waste does not exist and matter is simply transformed (Ganapini, 1985), production activities can optimize the complete product cycle and minimize the use of raw materials by giving priority to a continuous salvaging of resources and materials to be used again in other productive systems. Precisely like what happens in Nature: the residues of natural processes are continuously recycled to obtain living materials containing a wealth of potentialities.

## 2. Industrial agriculture

Since it was invented, agriculture has radically changed the ecological role of humanity. Thanks to this new activity, humans could stop depending on the limited natural produce made available to them by the local ecosystem and procure the food and nutrients they needed independently. Cultivating a field with the desired variety of vegetables meant clearing the land, cutting down trees, uprooting the

original bushes and grasses and preventing any possible regrowth. These plants try to reoccupy the land and are therefore considered by farmers as "infesting grasses" intruding on their natural territory (Eldredge, 2003). In recent years we have witnessed the gradual fragmentation and destruction of local habitats due to a growing introduction of allochthonous species to the detriment of autochthonous ones (Chelazzi, 2004) for the purpose of meeting the productive needs of current "industrial agriculture". According to paleontologist Eldredge, starting in the 1930s new high-yield varieties were cultivated and gradually substituted the traditional local varieties. However, being placed in a territory different from their original one, the new varieties needed external aid, i.e. pesticides chemical fertilizers, to be able to grow and ripen. And that's how it's been since then. The introduction of elements extraneous to the local ecosystem rapidly jeopardized the healthiness of foods and the environment itself. It is now clear that a considerable part of the damages caused to the earth by anthropic activities can be traced to current food production methods. Currently we are producing more food per person than at any other time in human history. This productive effort has stressed the Earth to the point that soils are dying from the exaggerated use of chemicals. These fields must be reclaimed periodically because nothing grows there, not even a single blade of grass. Biodiversity is decreasing by leaps and bounds, especially agri-biodiversity, leaving in its wake a drastically reduced number of animal breeds and plant varieties (Petrini, 2005). The book *Fatal Harvest* (Kimbrell, 2002) presents statistics on the loss of biodiversity in the United States alone. Of the over 5000 existing potato varieties, only four make up the overwhelming majority of those cultivated for commercial purposes; 80.6% of tomato varieties became extinct in the period from 1902 to 1983; the same thing has happened to 92.8% of salad varieties; 90.8% of corn varieties and 86.2% of apple varieties. We see the same desolating picture in intensive farming, whose processes have caused the extinction of numerous autochthonous animal breeds and a rise in the level of land pollution. To fertilize the land, farmers scatter manure filled with the antibiotics and chemicals contained in products used to feed them. Ranchers give their livestock antibiotics, even the healthy heads (Mességué, 2002). They administer hormones to accelerate their growth and other substances to keep them alive until the date planned for their slaughter. We stop expecting disease because they have been given antibiotics. Unfortunately the percentage of these substances remains in the meat destined for human consumption, thus causing a conspicuous drop in product quality and an increase in allergies. What is worse it causes an increase in human cancer. I would like to bring to your attention the case of Bretagne where the number of pigs raised has quadrupled in 25 years. This has lead to a situation where half of all French animal breeding is concentrated on only 6% of the national territory and consequently approximately 200,000 $m^3$ (Mességué, 2002) of excrement is dropped on soil. The problem is this: not only does the soil not require that much manure to be fertilized but – since it receives five times the amount of nitrogen it needs in this process and having been stripped of its natural elements, such as hedges and ditches – it can no longer retain water. The result is this: streams, which are estimated to provide approximately 80% of drinking water to the entire region, are filled with nitrates. Now that we are aware of this

situation, we realize that the breaking point was long ago broken and we now need to make a radical change in our mentality and behavior to restore dignity to the environment and natural resources. We must do away with intensive production activities, whether farming or ranching; we must implement a deindustrialization process in the agri-food business and prioritize productive systems closer to and more respectful of the natural rhythms of the ecosystem where they are established. We need to develop new forms of agriculture and breeding that can meet the needs of the human population while curbing the impact on the environment, protecting the fertility of the soils, rediscovering and prioritizing autochthonous breeds, defending biodiversity and minimizing the use of pesticides and chemical fertilizers in favor of using more natural methods. This need is also seen and felt by consumers. Whereas previously consumers expected farm produce to be clean, aseptic, polished and without blemishes, now they are demanding product safety in terms of health. Not only do people want to know the exact origin of the product as well as how it was grown or bred, they are also starting to show interest in the well-being of the animals being raised (Charvet, 2004), environmental issues and sustainable farming linked to the expertise and skills of the area where it is developed. By focusing on the close links between farmers and their crops, we can shed light on the relationship between local expertise (culture) and crops (Arzeni, 2003).

## 3. Local action to restore dignity to territorial specificities

To deindustrialize the agri-food business, productive processes must not be considered a sequence of actions that are independent from one another but as of whole set of actions. A holistic vision allows us to perceive the internal links, previously hidden and apparently invisible but indispensable for the functionality of the entire production cycle. Systems Design methodology reasons by connections. It challenges current industrial setups, emancipates us from a consumerist vision based exclusively on the product, and proposes a new production methodology. It considers humans as part of an ecological context whose interconnections and interdependencies are acknowledged and designs new flows of material and energy in the network of connections between different production units, whose interactions represent the pathways connecting the nodes and thereby defining the system's structure. This image of an enterprise network reflects the dynamics of a local ecosystem where the various organisms act as dynamic components that process material and energy and build close relationships with their surrounding habitats (Eldredge, 2004). Besides, in a vision of future development, the soil and the ways we use it cannot help but be the central focus of the discussion (Boggio, 2008) with the aim to build agrifood cycles that prioritize quality and the territory of the product and move away from the current production methods of large international food production and distribution corporations. Boggio maintains that "knowing how to read market trends and territorial specificities is a vital skill for new farmer-entrepreneurs" because productive strategies, whether for crops or livestock, are increasing influenced by local specificities, whether social, cultural, geographic or economic.

Productive activities are differentiated according to their specific characteristics. In spite of globalization – which has been affecting productive activities in recent years and causing the delocalization of production, among other things – it would seem that a large percentage of these activities place considerable importance on the territory because they cannot remove themselves from the socioeconomic setting in which they are developing. Harvey also maintains that global processes are not "footloose" but become "anchored" to the area in a combination of deterritorialization and selective reterritorialization. Local phenomena does not occur on one level along but are constantly connected and part of the whole of relationships that connect the various levels of the area, from local to regional, from national to global. The systemic approach reinforces the cultural identity of an area and preserves its biodiversity. This improves the productive and communicative qualities of the products generated there and the economic factors connected to the systemic energy sustenance of the enterprises involved. The basic idea of Systems Design is to observe the mechanisms of the Nature System, in which there is no concept of waste because what one species eliminates is what another species uses for its nourishment. Even surpluses are metabolized by the system itself. If these conditions, essential to any living system, are transferred to the world of production by applying the first principle of Systems Design according to which the waste (output) of one productive system can be used as a resource (input) for another (Bistagnino, 2008), we will be promoting the type of production that moves towards zero emissions. In such a scenario all the actors involved in the production chain will start to reason by connections. Faced with the incapacity to introduce new techniques for managing the problem of waste, we are still using dumps. Nonetheless these should be considered a transitory and temporary solution. Therefore systemic methodology proposes a new approach that stimulates people and companies to reduce all forms of waste and helps valorize the remaining outputs by giving them a new economic and legislative value . This way not only the so-called waste products are elevated to a status of materials worthy of proper, controlled and more sustainable management, but they can "move" within the production chain with new positivity and dignity.

## 3. Systemic Software input/output

Our current industries throw away most of the resources they take from nature: for example to manufacture paper, entire forests are cut down to use only 20-25% of the trees (Capra, 2004), while all the rest of the resource is thrown away as waste.

To restrain this phenomenon we need to create an instrument for making the changes needed on the level of the management, organization and procurement of energy and resources. We can start seeing the importance of creating an IT instrument for study and analysis based on the concept of an open-loop system that can help neighbor companies, according to their business purpose or geographical location, to organize themselves into "ecological networks" to achieve production that moves towards

zero emissions by means of sustainable management and the valorization of waste. Moreover, profits can be obtained from the sale of these outputs (waste). This would create new flows of material that would connect different companies. These enterprises could reach a condition of reciprocal advantage by allowing the reutilization of the materials put out by their production processes. The constant exchange of information and sharing of knowledge between the players involved allows a continuous systemic culture to spread, along with the concepts of prevention and the ongoing improvement of the environment. In such a system the flows of materials generate internal links and relationships through single local systems can be defined. These systems would connect the various systems on a regional level and ultimately on a global level. Underlying these concepts we find the fundamental ways to procure resources in an ecosystem: the production of material in loco by using energy obtained from the surrounding environment and the importation of material produced and released by other ecosystems (Chelazzi, 2004). In this specific case the territory being studied is Piedmont Region. Its production is mainly metalworking, textiles, agriculture and cattle breeding. The starting point is to consider that the waste from these production processes, currently thrown away and not valorized, abound in precious resources for other manufacturing activities. According to the systemic methodology, production systems are observed according to their internal and external relations (with related industries), for the purpose of energy use, emissions control, procurement, the transportation of material and the management of outputs on the territorial level. They are redefined during planning and design and the outcome is a complex, ramified, multi-polar and strongly territory-linked operation. In these cases the waste is transformed into a productive resource and new relations are arise between local companies, thereby minimizing the use of external resources and allowing greater clarity in terms of the traceability of the production chains.

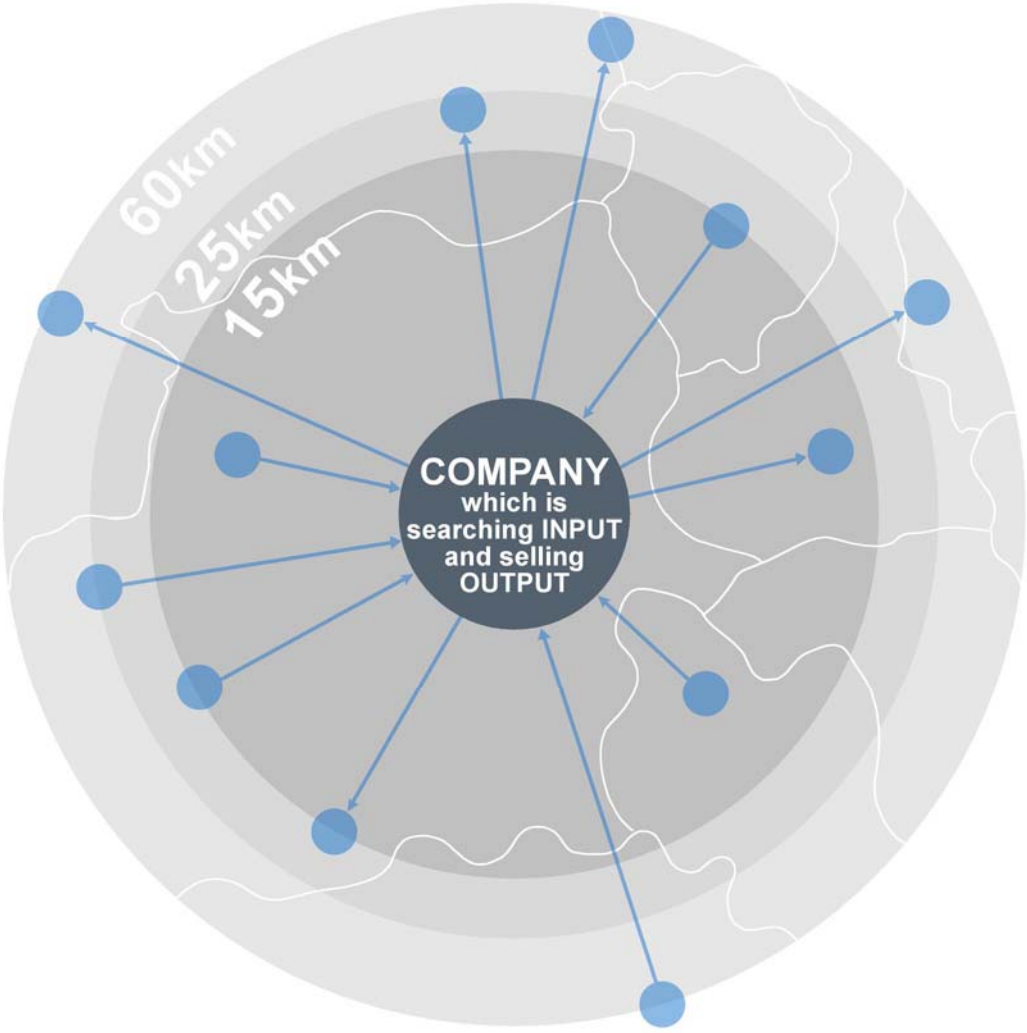
This also helps determine which local activities can be related in an open-loop production system and what types of outputs can be reutilized by other production categories. From the information given on the MUD (Consolidated Environmental Declaration Form on which companies are required to declare the waste they produce, collect, treat or eliminate, send to be recycled or transport) we can see that currently approximately 142,000 tons of the waste produced per year by agriculture, aquaculture, horticulture, forestry, is used as fuel or brought to the dump or destined to biological-physical-chemical treatments for the purpose of producing compost or mixtures to be eliminated by scattering them on the soil or storing them in permanent warehouses. The same applies to the approximate 75,700 tons per year of waste produced by woodworking. These practices not only prevent exploiting the intrinsic wealth of these materials optimally but also cause a notable squandering of resources that can be used in other type of production. Moreover it is important to note that they also cause potential environmental hazards. To prefigure the use of outputs as resources in a new process, we attentively examine the quantities and qualities of waste produced currently on the regional territory of Piedmont and then categorize them according to their physicochemical and biological properties. We then determine possible fields of use for them. The results show the differences and advantages between the

current production process according to a linear structure and the new one that proposes an open-loop industrial system based on sequence: quantity/quality of output> reutilization of output> resources> profits. As a matter of fact we find ourselves facing not only a merely environmental issue but discover that there is a possibility to create a network for selling one's outputs. The implementation of these concepts shows us how important it is to create and use an instrument that allows companies to connect to each other and act locally. This instrument must be created by the combined use of a computer and a network of shared knowledge and communication that allows a flow of different types of information such as texts, images, animations to be transmitted digitally. In specific, we propose the definition, design and realization of a system, the Systemic Software, for processing information based on evolved technological systems that can acquire, catalog and organize information relative to the productive activities in the area of study, the outputs produced and the inputs required as resources; this data is acquired and organized in terms of quantity, type, quality and geographical location on the territory. All the data are correlated with each other by means of a complex logic. The logic and the algorithms that intervene on the acquired information serve to normalize the structures, allowing them to be interlaced and evaluated by evolved technological instruments which serve to render the information in an intelligible and intuitive format for all of those who interface with the Systemic Software. The consultation of the system was designed by following the systemic approach and made usable by means of Web 2.0 technologies; this approach has made it possible to publish an interactive Web portal as a facility that can be used by operators who want to consult it and interact with it. We start with the premise that the availability of new raw materials must definitely be measured according to type, quantity and quality; but it is essential to also evaluate their geographic location. This is the added value that Systemic Software offers companies and the community in which they are located. The processing system, developed in collaboration with Neosidea Group, was also supplemented with the function of geo-locating business is and materials and this provides a solution and that gives not only information regarding new areas of application of the outputs but also determines with precision and localizes by territory the flows of material within a local network whose nodes are represented by the companies present on that territory: by doing this valorize and encourage local economies and provide an accurate evaluation of market opportunities in areas not yet using and benefiting from the systemic approach. This technology makes it possible to obtain different levels of information regarding new business opportunities related to the companies on the network.

Thanks to the development of a structured implementation logic based on the systemic vision, the information processing instrument or systemic software, is able to provide further information to set up new production chains and new flows of materials and services in favour of all the businesses who join the initiative thanks to a constant updating and comparison among the systemic logics for reusing materials, local productive activities and the territory itself. With the creation of this software we are proposing that short chains be set up in the production sphere that allows operators to contact local companies to procure resources or set up operations to reuse outputs for the purpose of reinforcing the

bond with the local territory. According to this logic, the radius of action for the exchange of materials will not be greater than 50-60 km. It will reduce the time needed for procurement and the impacts of long-distance transportation.

**Figure 1: Results obtained about the geographical localization of the companies which are the network nodes.**




The greatest innovation offered by this approach consists of raising the awareness of producers that the problem of waste can be solved by activating complex relations in which the outputs of one productive process connect the nodes, which are local companies, of a network in which know-how, well-being, material and energy transit. The advantages of such an approach are environmental and economic; among these the most important goal is to reduce the cost of waste treatment and therefore increase the profits from selling the company's outputs, reducing environmental costs, such as the consumption of energy, pollution and traffic caused by the transportation of materials; the use of

already existing materials in loco removes the need to exploit virgin raw materials. The functions of the systemic software are fourfold:

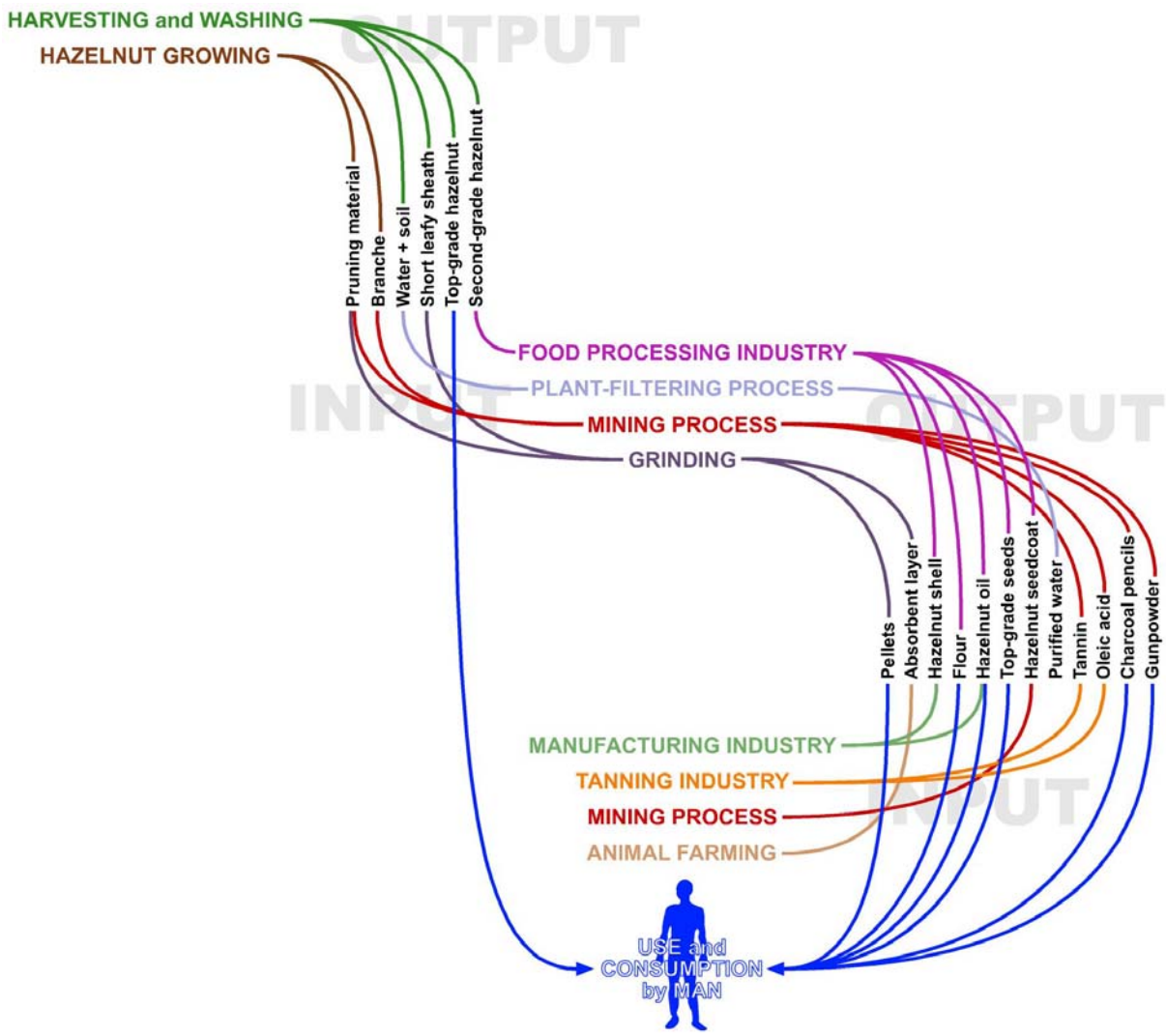
- producers of waste would be able to determine which local companies could use their outputs as resources in their production process;
- it tells input-seekers which companies produce outputs they can use as resources;
- it informs different producers about new business opportunities on the local territory that have previously remained hidden;
- it is an efficacious instrument for evaluating the entire production process and becomes an instrument for providing feedback.

Therefore this system can give useful and reliable information regarding one's current production process: if you enter the type of waste produced by your company as a search criterion, and the Software gives no results for possible reutilization of your outputs, this means your current production process makes waste that cannot be reused or recycled. It means your company produces items by using inputs and processes that do not comply with the vision of an open system. Therefore we have observed the need to implement certain changes within the production line, for example to reassess current inputs and substitute them with others that are more environmentally sustainable. Essentially we are proposing an IT network at the service of the environment, a web that speaks to the earthly roots of humanity and the deep need for a revived attention to nature and the resources it offers. The huge amount of data obtained by using Systemic Software is a precious asset and a vital platform for scholars of the environment, researchers, ecologists, public agencies, local administrators and, obviously, for entrepreneurs. The last mentioned actors will be able to work in a more sustainable way. The advantages of such an instrument are that they: improve usability, facilitate use and satisfaction, expand the potential area of users, improve the use of technological resources and local resources, raise the quality of life of society whose health depends on the way it relates to the environment hosting it, valorize the potentialities of the local territory and of the economy itself. The proposal of a technological support of this type arose from the consideration that this "virtual" web allows us to react more rapidly when confronted with environmental issues, involve different areas of users, and have a positive influence on decisions and actions taken by public institutions as well as on producer companies. It is an indispensable instrument for gaining thorough knowledge about one's own territory, discovering and valorizing its potentialities by sharing the knowledge of different people and entities and enabling collaboration participated in by all of the actors involved. We are talking about "an ecological and systemic web", made for the human (Boscarol, 2003) dimension that can create a positive growth-promoting relationship among its users and to elaborate flexible and creative solutions thanks to the capacity to involve all of the interested parties through rapid technological means that are continuously being developed.

### *3.1 Case study: the hazelnuts systemic production*

This document sets out to illustrate the case of hazelnut cultivation, which currently considers scraps as useless material, discarded and sent them to the dump. Considering the entire production cycle, we could find new connections that until now have been invisible because of the linearity of the current process. In the proposed system some of the pruning scraps are sent to be minced and made into pellets. The rest is sent to extraction companies which make tannin and oleic acid, also contained in the hazelnut seed coat. These substances are then used for tanning leather. The branches of the hazelnut tree are sold as raw material because, due to the excellent quality of the wood, they produce charcoal for drawing and gun powder. The short leafy sheaths can be used as absorbent layer on the floor of animal stables. Lastly, the seed shells can be made into pellets while the hazelnut oil has two uses: direct consumption by humans and applications in the pharmaceutical or cosmetics industry for the production of essential oils and emollients.

**Figure 2: New flows of material obtained by querying the Systemic Software input/output.**



## 4. Conclusion

Zaccai's concept according to which “the efficiency of technology is one of the factors that can help us reduce the pressure of human activity on the local environment" is implemented with Systems Design methodology and Systemic Software the development. The proposal for a technological instrument of this type also makes it easier for the various community actors to understand, on different levels of complexity, the numerous possibilities offered by systemic culture tout court but particularly Systems Design applied to a productive area. Therefore the research aims to render knowledge about the systemic-designed instruments of the approach explicit and more accessible. The combination of this knowledge and technological support instruments improves understanding of the environmental and the economic benefits generated by a systemic nonlinear territorial productive culture which enables us to transform waste into materials worthy of a proper rational use. Such an approach is aimed at an optimal management of the waste/materials. More importantly it aims at the profitably reutilization of these materials. This reinforces the concept that effective environmental protection is not in conflict with the economic growth of enterprises. The contribution of systemic methodology to the valorization and protection of any given territory is therefore fundamental. In fact creates the context for a set of links between energies and materials, productive systems that are self-sufficient in terms of energy, production and procurement. All of this has close connections to the local expertise and skills which can correspond to the human need for well-being according to the rhythms of natural cycles.

**References**

Arzeni A., Esposti R. and Sotte F. (2003) *Agricoltura e natura*. FrancoAngeli, Milano.

Bistagnino L. (2008) Ispirati alla natura. Slowfood n. 34, Slow Food Editore, Bra (CN).

Boggio F., Dematteis G. and Memoli, M. (2008) *Geografia dello sviluppo. Spazi, economie e culture tra ventesimo secolo e terzo millennio*. UTET, Torino.

Boscarol M. (2003) *Ecologia dei siti web*. HOPS, Milano.

Capra F. (2007) *The Science of Leonardo*. Doubleday, New York.

Capra F. (2004) *The Hidden Connections*. Doubleday, New York.

Charvet J.P. (2004) *L’alimentation dans le monde - Mieux nourrir la planète*. Larousse, France.

Chelazzi G., Provini A. and Santini, G. (2004) *Ecologia dagli organismi agli ecosistemi*. Casa Editrice Ambrosiana, Milano.

Ecocerved, www.ecocerved.it

Eldredge N. (1998) *Life in the Balance. Humanity and the Biodiversity Crisis.* Princeton University Press, Princeton.

Frey M. (1995) *Il management ambientale*. Franco Angeli Editore, Milano.

Ganapini W. (1985) *La risorsa rifiuti*. ETAS Libri, Milano.

Mességué M. (1999) *Sauver la terre pour sauver l'homme*. Robert Laffont, Montréal, Canada.

Petrini C. (2005) *Buono, Pulito e Giusto*. Einaudi, Torino.

Pauli G. (1996) *Breakthroughs-What business can offer society*. Epsilon Press, Surrey, UK.