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Rural-Urban Symbiosis

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Preface

Residues originate in rural and in urban systems. Many contain biogenic ingredients, e.g. food and green waste, livestock manure, feces, sewage and other sludge's, harvest residues, digestates, agro-industry residues, and more. Commonly residues are known to pollute environments, cause hygienic problems or they are cost-intensive to collect and treat. Since fossil raw materials are becoming scarce, biogenic residues are more and more a topic of utilization. Application options are manifold. They range from energetic utilization, e.g. to provide electicity and heat for households, industries and agricultural facilities, up to substantial applications ranging from bulk products such as composts and specific products like mineral fertilizers or biochemicals. A special challenge is the interface between rural and urban systems. In this context the mutual understanding is often limited, usually due to a lack of knowledge or contradicting interests.

The conference aims at providing information on the state-of-the-art and on innovations, strengthening cooperation and interconnections among different stakeholders and working out deficits as well as finding solutions for a better understanding and for improved material flows.

The abstract book contains conference contributions to following areas:

- Keynotes on interdisciplinary issues (K: 3 oral presentations)
- Quality fertilizers from residues (TA: 29 oral presentations and 22 posters)
- Sustainable soils (TB: 8 oral presentations and 6 posters)
- Advances in emission prevention (TC: 25 oral presentations and 17 posters)
- The bioresource challenge (TD: 21 oral presentations and 8 posters)
- Sustainable regions (TE: 22 oral presentations and 12 posters)
- General thematic lectures (G: 5 oral presentations)

To deepen networking and to strengthen interdisciplinary not only among researches, but also with practitioners, politicians and public, some further initiatives were included in the conference:

- Podium discussion on rural-urban symbiosis
- Science and art presentations
- Manure management post-conference workshop
- Urban gardening post-conference workshop

The conference was attended by more than 200 delegates from more than 30 countries. Additional to the abstracts, reviewed 4-page-papers are available from the RAMIRAN webpage (www.ramiran.net). Selected contributions were additionally invited for a more detailed publication in a special issue of the open-access online Journal „Energy, Environment & Sustainability".

Ina Körner
Conference Chair

About RAMIRAN

The "Recycling of Agricultural, Municipal and Industrial Residues in Agriculture Network (RAMIRAN)" is a research and expertise network dealing with environmental issues relating to the use of livestock manure and other organic residues in agriculture. RAMIRAN evolved in 1996 from the much smaller FAO Animal Waste Network, that had been active since 1978, and the scope was expanded to include other organic residues (industrial and municipal) which are used on land as organic manures and soil amendments. It is in principal a European network, but it is also open to interested experts from other parts of the world.

The network provides an invaluable means of exchanging ideas, information and experiences on topics that are becoming increasingly important at a national and international level. The main objectives of the network are to:

- Promote the exchange of methodologies, materials and processes;
- Progress knowledge on the environmental assessment of organic residues recycling in agriculture;
- Identify research priorities and initiate innovative collaborative activities that make use of the synergies resulting from the international network.

The main activity of RAMIRAN is a scientific conference organized every two years, usually attended by 150-250 participants. The RAMIRAN conferences are respected as the leading event in the field of manure and other organic residues used in agriculture in Europe. They provide an extensive overview of ongoing research and knowledge transfer activities concerning manure and other organic residues. This overview of *who is who* and *who does what* is an important prerequisite to the networking activities that RAMIRAN wants to foster.

With its participants, RAMIRAN holds a tremendous resource of knowledge and expertise in a wide range of topics across the whole of Europe and some countries in Northern America, Asia and even Oceania. The network represents a unique opportunity to mobilise this resource through network activities above and beyond the regular conferences. To use this potential, RAMIRAN fosters task groups, short-term teams with a clear task that can be achieved in a defined time of ideally 1-2 years and maximum four years. These tasks make use of the potential of RAMIRAN arising from its membership of experts. This means that, for example, surveys about management techniques, environmental, economic or social issues in connection with manure and other organic residues or interdisciplinary studies are ideal topics for such tasks. Past examples include residual Nitrogen effects from organic residues, anaerobic digestion and utilization of digestates. In 2003 and 2011 a group produced a "Glossary of Terms on Livestock Manure Management" which has proved very valuable in harmonizing the use of terms relevant to organic residues and their environmental relevance. At the 2013 conference in Versailles, it was suggested that the Glossary should be translated into different languages (a Russian version is now available) and that RAMIRAN should support its members to produce "Country Manure Profiles" providing an overview of the current practices and knowledge concerning organic residue management in the different countries.

With the special topic "Rural-Urban Symbiosis" the 16th RAMIRAN conference is focusing on closing the loop linking rural production and urban consumption systems and on the development of more sustainable solutions for the handling of residues. Once again this reflects the changing perception from waste and emissions towards benefits and resource use efficiency that has occurred throughout the lifetime of RAMIRAN. As Co-chairmen of the Network we thank the organizers for arranging this exciting and successful conference!

Tom Misselbrook and Harald Menzi
Network Coordinators

Thematic areas of RAMIRAN 2015

TA: Quality fertilizers from residues

Agricultural production depends on the supply of plants with nutrients. Efficiency in agricultural production considers not only yields, but also product qualities and fertilizer footprints. Fertilizers provide nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), and sulphur (S) as macronutrients in varying proportions and forms. Furthermore micronutrients are needed in trace amounts, which are valuable not only for plant production, but also in follow up chains such as food consumption or anaerobic digestion. Trace nutrients in many foods have declined over the last half century and rock phosphate as the main source of P fertilizers will deplete in 50-100 years. In some locations, over-fertilization leads to water contamination, while in others high fertilizer prices leads to nutrient deficiencies in soils. The main source for N fertilizers is ammonia generated via the energy intensive Haber-Bosch process from atmospheric N. It is estimated that this process alone demands around 1.4% of the world's total energy consumption. Agricultural, municipal and industrial residues contain varying quantities of N, P and other nutrients and trace elements. They are often disposed of with environmentally damaging effects or through costly treatment processes e.g. by waste water treatment or incineration.

TB: Sustainable soils

Soil is a living body. It is a complex medium comprising mineral particles, organic matter, water, air and living organisms. Soil is an essential, very slowly-renewable resource, which provides many vital ecosystem services such as food and the production of other bioresources as well as filtration and retention of toxic substances and nutrients. Demands on soil are increasing as the world population and the per capita food demand continue to grow. In addition, the pressure to reduce consumption of fossil resources has led to a growing demand to provide bioresources as alternative sources for energy and raw materials. Soil overuse is increasingly leading to soil degradation, both in the EU and at a global level up to desertification. In line with sprawling urbanization, arable land is decreasing in quantity as well as in quality. Lacking direct legislation, soil degradation is now having trans-boundary impacts along with high economic costs. One means of improving soil quality is the use of organic residues generated by human activities as soil amendments for enhancing soil carbon levels and soil structure. However this practice is not without risks, namely the introduction of harmful substances such as antibiotics and other pollutants or unwanted nutrient losses.

TC: Advances in emission prevention

Farming is a source of emission of pollutants to the atmosphere and to water. A well-known problem is nutrient leaching and surface run-off, which may cause eutrophication of surface and groundwater bodies and is detrimental to drinking water quality and human health. The most-studied climate relevant gases are methane, carbon dioxide and nitrous oxide. Their atmospheric concentrations have increased in the last centuries due to human activities, including agriculture. Another important rural emission pathway is ammonia volatilization, arising largely from livestock manures and urea-based fertilizers. Together with other reactive nitrogen compounds, e.g. NO_X from processes in transport and industry, it leads to N deposition that damages susceptible ecosystems and leads to soil acidification Particulate matter originates from a range of agricultural sources, in particular the formation of secondary particulates from ammonia emissions, and may lead to a variety of health problems and associated social costs. In the future emissions may also be caused by new anthropogenic substances/compounds such as nanoparticles from nanomaterials. Urban emissions are numerous and may lead to the introduction of polluting substances (antibiotics, pharmaceuticals, heavy metals etc.) into agricultural chains with a feedback on urban systems.

TD: The bioresource challenge

The sustainable use and the protection of natural resources are essential for enduring food production and quality of life. In this context, bioresources will play a key role. Bioresources are non-fossil biogenic resources which can be used for multiple purposes: to produce food, substantial products such as paper, biobased plastics, biochemicals and composite materials or energy carriers such as bioethanol, biogas and heat. Bioresources are renewable, but they are not available in unlimited quantities and have limits to their utilization. Biobased economy encapsulates the vision of a future society no longer wholly dependent on fossil resources. The basics are bioresources originating from plants, animals, microorganisms or residues. In biorefineries they are converted into a multitude of products such as chemicals, materials, feed, fuels, and other energy carriers. Biorefineries are complex and integrated systems consisting of many process units. They take advantage of the various components contained in bioresources such as cellulose, hemicelluloses, starch, lignin, proteins, fats, oils, extractives and their intermediates. To date, the biorefinery industry is still in a nascent state, mostly using ligno-cellulosic feedstocks on larger scale. However, many concepts and approaches exist. Frequently discussed biorefinery systems with a connection to agriculture include sugar, starch, vegetable oil, lignocellulose, green, synthesis gas and biogas biorefinery.

TE: Sustainable regions

A sustainable agricultural system aims to deliver sufficient productivity, through the use of minimal and non-hazardous inputs, while maintaining soil quality and contributing to the reduction of environmental problems. The recycling of residues for fertilizing and soil quality improvement is still limited in practice. But urban and rural residues are increasingly not only a topic of disposal but of utilization. This provides an opportunity to bring rural and urban systems closer together again. However, practices involving recycling of residues might also cause environmental problems and lead to the evolution of unwanted compounds and pests.

Zero Waste is a visionary goal connected with changing people's lifestyle and behaviour and traditional waste management practices. A holistic and integrative approach for their improved utilization is the "Civilization biorefinery" - a system aiming for complete and efficient utilization of secondary, tertiary and quaternary regional bioresources in a rural-urban symbiosis. It consists of three major parts - collection of the local bioresources, their conversion in a local network of centralized and decentralized technical units into material and energy products and the utilization of these products.

Towards Nitrogen neutrality at RAMIRAN 2015

Nitrogen (N) is an essential element for food provision - plants need to be fertilized and animals as well as humans need N as a nutrient too. But N can also cause manifold problems. There are *problems of too much N* - losses into environment contribute to eutrophication, acidification, global warming, and more. But there are also *problems of too little N* - soil resources depleting and endangering the livelihood of farmers, and threatening food security. A lot of effort is needed to better balance N-management.

The concept of N-neutrality recognizes that there are institutional and individual responsibilities. A large event like RAMIRAN 2015 causes a considerable N-footprint that needs to be offset. By participating in the N-neutrality program we want to raise awareness of the topic and show possibilities for progression towards N-neutrality. To become N-neutral, the approach suggested by the European Commission's Joint Research Centre (JRC, Institute for Environment and Sustainability Monitoring of Agricultural Resources) was considered.

At RAMIRAN 2015 the following activities were taken into consideration to lower the footprint or reactive nitrogen (Nr):

1. **Provision of tasty food with reduced Nr impact at RAMIRAN 2015**

   Our first aim regarding food was to provide tasty food in sufficient amounts. But we also selected the menus regarding their N-footprint. For the lunch break we evaluated 28 meals and selected 10. In the coffee breaks we provided various selections of fresh fruits, which have generally a low N-footprint. Additionally the unconsumed fruit mixes will be given to needy people. For the gala dinner a table served menu was chosen instead of buffet to reduce food waste. Furthermore we asked for special diets of the participants (mixed cost, vegetarian, vegan, allergies and intolerances) in the registration procedure and considered the results in food provision.

2. **Calculating of the Nr-impact of RAMIRAN 2015**

   The N-impact of food provided at RAMIRAN 2015 was calculated on the basis of the N-footprint approach by Leip et al. (JRC). For that purpose we collected data regarding type and amount of all menu ingredients. For instance the average N-footprint of the meals prepared for lunch had a 9 % smaller Nr-footprint compared to an earlier conference in the same canteen and same working days. Additionally we studied the waste generation and the waste whereabouts in order to find out about used, recovered or lost Nr amounts.

3. **Compensating the Nr-impact of RAMIRAN 2015**

   All participants of RAMIRAN 2015 were asked to contribute a voluntary compensation fee (30 €) to equalize the remaining N-impact of consumed food as much as possible. The money will be donated to a sustainable food project in Indonesia (BEST, Institute for Integrated Social Economic Development, NGO) which focuses on demonstration of vertical gardening as a special urban farming solution e.g. for onions, lettuce and celery. The installations have the potential to be widely used in urban areas contributing to the provision of high quality food, helping 'reconnect' people with their food systems, and save land.

More information to the N neutrality approach and the calculations for the lunch meals are to be found in this abstract book (Leip et al., 2015, page 10).

Art at RAMIRAN2015

"Art is the queen of all sciences communicating knowledge to all the generations of the world." Leonardo da Vinci

The conference is not only an interface between rural and urban regions as well as between scientists, practitioners and politicians. It also shall connect the practical world with culture and art. Following artistically activities were carried during the conference to give it an communicative, but also enjoyable and relaxing atmosphere:

Acting for sustainability: A group of young researchers and practitioners with interdisciplinary experience in environmental governance uses theatre to promote intercultural dialogue on sustainability in the context of academic and public conferences. By combining scientific knowledge with artistic expression they appeal to the emotions, thus engaging their audience at a deeper level than can be achieved through mere intellectual argumentation and create a level of communication that engages participants with the heart as well as the mind.
(http://scientific-theatre.org/; Freiburg Science Theatre, t.floerkemeier@scientific-theatre.org)

Art from tetrapak: Christiane Lüdtke is a Hamburg artist. Sculpturing is one line of her activities. At RAMIRAN 2015 she presents a further line: etchings from tetrapak materials. Etching is traditionally method of printmaking where a metal surface is used to create a relief, which delivers the printing matrix. Mrs. Luedke is using Tetrapak as printing matrix which gives the pictures a very lively structure. She presents funny etching from various human situations as well as book marks.
(http://christianeluedtke.de/; kunst@christianeluedtke.de)

Rural-urban colors: Photographic images – original and artistically edited – were arranged to relaxing films for the conference breaks and upgraded with some statistical data to the conference for information. The focus of the images is on structures and colors from urban and rural environments taken from various distances. It ranges from extreme close-ups, where very small subjects appear in the photograph greater than life size up to photos taken with wide perspective.
(http://www.bioresource.eu; BioResourceInnovation, BRI, i.koerner@bioresource.eu)

Art at the Hamburg University of Technology: TUHH hosts various artworks ranging from photographs, over paintings up to sculptures, partly from internationally known artists (e.g. Hanne Darboven, Berto Lardera, Chui Wang, Alfred Mahlau). They are distributed within the buildings and the campus park. Some of the most impressive artworks were explained via a tour through the university. Information includes the manifold ways they came to the university, the techniques used and the partly difficult standing of art in a technical environment.
(http://kunst-tuhh.de/; stieglitz@tuhh.de)

The cell factory: Biorefineries are the foundation of the biobased economy. The major actors in biorefinery systems are microorganisms. The complexity of the processes within a microbial cell was visualized via a 3-D-model with an almost 1-meter-diameter. The model represented a fungal cell including their organelles. Also various enzymes were visualized in 3-D-form. The exhibition unit is accompanied by biorefinery feedstockes and products.
(http://www.tuhh.de/ibb/home.html; aze@tuhh.de).

Examples are shown on pages (1, 5, 11, 41, 64, 73, 80, 106, 124, 146, 155, 178)

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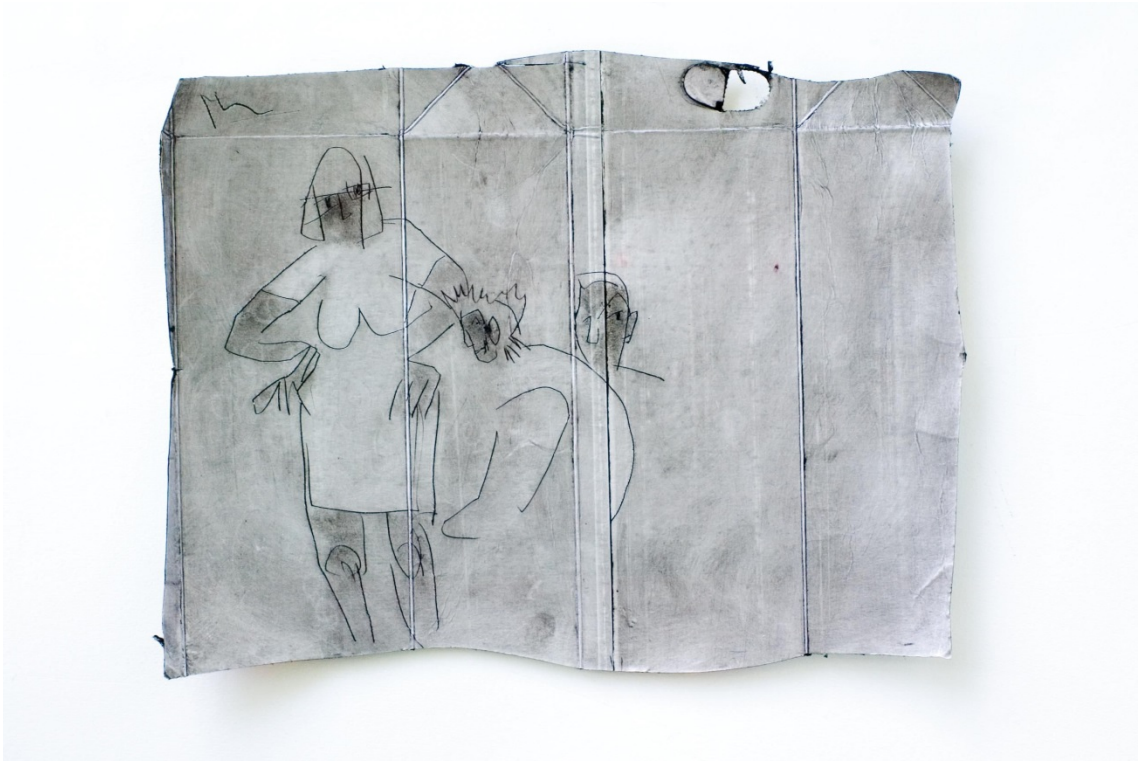

Christiane Lüdtke: Art from Tetrapak

TE-P_03 Systemic approach applied to a Mexican rural area, in order to improve the quality of life and economic well-being of people

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Objectives

Promote economic diversification combining traditional agricultural skills and new technical know-how.
Support and develop agro-food systems, thus contributing to sustainable, inclusive and economic growth in rural regions.

Case-study description

The project is located in Ahuacuotzingo, a Mexican rural area, State of Guerrero chosen because of its particular features related to food, both production and consumption. Take action on these aspects has environmental, social, economic and health consequences.
The area is characterized by low population and enterprise density, high unemployment and emigration, especially to the United States. This situation generates a radical change in food consumption and lifestyles, and a loss of material culture and know-how, because some people try to imitate other cultures losing totally its own know-how.

Observation

The population of this rural area, rather isolated, reveals to be intimately and intensely linked to the territory and to have a strong sense of belonging and aggregation. In addition, the farmers of the cooperative Ahuehuetla, with which we are working, they are very motivated for a substantial change towards sustainable rural development.
The Systemic project started from the analysis of the activities of six farmers in order to identify the materials and energy flows, and the main critical aspects.
The second step is the flows design according to the intention of tending to zero waste. The objective is to reach the satisfaction of the agro-food demand of the people of Ahuacuotzingo by intervening on production but also changing dietary habits. The project aims to produce healthy, local and clean food, linked to the rural Mexican tradition. Also educational and social aspects are important: the Ahuehuetla cooperative owns a community space (Cavideco), where it is possible to make and sell food, as well as being a meeting point for seminars and workshops. Cavideco could be the link between the cooperative and the population, so that both can benefit from the systemic project.

Methodology

The methodology applied in this project is the Systemic Design Approach, because it plans open systems with a strong reduction in the waste production and with benefits for the whole community: from a better environmental quality to the creation of new job placements. The first guide-line of this approach is that the waste (output) of a system must become resources (input) of another system. In this way the system generates for itself resources, content and meaning, by updating and developing independently.

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