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.