Simulation of Carbon Consumption by Biological Models

Olaf Pollmann, Nelli Pollmann, Szilárd Podruzsik, Leon van Rensburg

Contact details and biographical notes:

- *Dr.-Ing. Olaf Pollmann*, School of Environmental Science and Development, North-West University, Potchefstroom Campus (PUK), Private Bag X6001 (Internal Box 178), Potchefstroom 2520, South Africa, Cell: + 27 (0) 76 / 844 70 96, Fax: + 27 (0) 18 / 294 57 40, E-Mail: 20942737@nwu.ac.za

  Dr. Pollmann studied civil engineering majoring in water-supply, particularly environmental engineering and technical waste-management as well as additional environmental management techniques at the Gottfried Wilhelm Leibniz University of Hannover in Germany from 1995 to 2000. From 2001 to 2006 he worked as a research scientist at the Leuphana University of Lüneburg. In October 2006 Dr. Pollmann finished his Doctorate (Dr.-Ing. / PhD) in the field of environmental-informatics at the Technical University of Darmstadt, Germany. From January 2007 he works as a post-doctoral research fellow in the field of waste reduction and water purification at the Department for Environmental Sciences and Development, North-West University, Potchefstroom Campus in South Africa.

- *Nelli Pollmann*, SCENSO – Scientific Environmental Solutions GbR, Bonn, Germany, Tel. +49 (0) 2241 / 1457 780, Fax. + 49 (0) 321 / 212 32 060, E-Mail: n.pollmann@scenso.de

  Nelli Pollmann is a state approved technical draftsperson for civil engineering, urban road construction and landscape construction and a state approved engineering technician for civil engineering with the topic of underground construction (both by German Chamber of Industry and Commerce (IHK)). She got advanced experience as a research assistant at the North-West University, Department for Environmental Sciences and Development, and as an engineering technician at Redco – Rehabilitation Design & Construction Services (pty) ltd in South Africa.

- *Dr. Szilárd Podruzsik*, Corvinus University of Budapest, Department of Agricultural Economics and Rural Development, Fővám tér 8, 1093 Budapest, Hungary, E-Mail: szilard.podruzsik@uni-corvinus.hu Tel.: +36 1 482 61 78

  Dr. Podruzsik is an economist. He holds a PhD in economics from the University of Economic Sciences and Public Administration in Budapest. He works for the Corvinus University of Budapest as a senior lecturer. His research fields are the agriculture and food industry. Currently his research focuses on the food consumer welfare, food logistics and its process optimisation. In his research he applies different models help to stimulate, estimate and evaluate the sector.

- *Prof. Dr. Leon van Rensburg*, School of Environmental Science and Development, North-West University, Potchefstroom Campus (PUK), Private Bag X6001, Potchefstroom 2520, South Africa, Tel: + 27 (0) 18 / 299 15 42, Fax: + 27 (0) 18 / 299 15 44, E-Mail: Leon.vanRensburg@nwu.ac.za

  Prof. van Rensburg started his academic career by obtaining his BSc, BSc Honns and MSc (all cum laude) at the PU for CHE (now NWU). Up to 1994 with the completion of

his PhD he focused on understanding and quantifying plant responses to environmental stress, i.e. what plants experienced as being stressful environments and how they responded physiologically to be able to cope with the stressor/s. Up to his appointment as Director of the now Research Unit for Environmental Sciences and Sustainable Management he has conducted numerous research projects in various climatic regions (locally and internationally) and on a large number of different mine discard materials for various large.

ABSTRACT

Since the 1970's, the shortage of available and usable resources has been seen as the 'limit to growth' (Club of Rome, 1972). Since then, the regenerative-ability of the environment - its ability to absorb harmful substances and waste products, has achieved a similar standing. Critical ecological examination must take the beginning, but also the end, of the production chain into consideration, and thereby give equal weight to the exhaustion of important production materials (energy, raw materials) as well as to the over-stretching of the ecological reproduction capacity of the Earth.

To recognize the carbon influence in production processes it is necessary to balance anthropogenic material streams. For production processes and material recycling the smallest common and not further reducible indicator is carbon. With knowledge of requirements it is possible to reduce carbon consumption as a becoming scarce natural resource and fossil fuel which is used in different production process. Therefore the material fluxes as the product of density (mass by volume) and hydrologic flow velocity (distance by time) must be known for every place and time of the production process. This investigation shows that the annual input and output of carbon in process are almost balanced. With this carbon-balance it is possible to identify resources and depressions of carbon and to point out approaches for optimization. Mostly material streams show a flow of valuable materials which can be merchandised if the quality is still right. This also reflects the strategy of cradle-to-cradle.

To evaluate these anthropogenic impacts of pollutants on the environment or material streams in the natural circle it is indispensable to use the benefits of computer systems – in particular artificial intelligence. Most of impact factors are time related and therefore difficult to calculate and to optimize in a natural environmental system. By using evolutionary algorithms as a part of the artificial intelligence to simulate, estimate and evaluate pollutants or specific materials it makes it possible to evaluate the impact on the environment and to optimize material streams in nature or recycling streams.

Keywords: Resources, Recycling, Cradle-to-cradle, Anthropogenic material stream optimization, Evolutionary algorithms