

Substance flow analysis for nitrogen and phosphorus in Flanders

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Summary

The region of Flanders in Belgium has a nutrients surplus available in waste streams such as domestic wastewater, organic biological waste and animal manure, due to its high population density and intensive agriculture and industry. It therefore possesses a large potential towards the recovery and reuse of nitrogen and phosphorus. In this study, a substance flow analysis for nitrogen and phosphorus is presented, quantifying the fluxes, stocks and hot spots of both nutrients within Flemish system boundaries for the reference year 2009.

A graphical model was developed which divides Flanders into 13 economic and environmental sectors: the food industry, the feed industry, the crop production, the animal production, the households and distribution, the waste treatment, the waste water treatment, transport and energy, the biomass treatment, the chemical and other industries, the air compartment, water compartment and soil compartment. For each sector the fluxes of resources, products and waste streams were quantified for the year 2009, together with their nitrogen and phosphorus content. Afterwards, the graphical model was translated into a mathematical model using the STAN 2.5 software package (Technische Universität Wien). The nitrogen and phosphorus fluxes throughout the system were further visualized to display the relations between the different sectors of the economy and the environment, as exemplified in the figure hereunder. The results were used in a last phase to determine indicators for each sector, firstly as described in this study and secondly as set by the environment report of Flanders (Milieurapport Vlaanderen), based on the share of each sector in the total streams of nutrients, and on the export and import data.

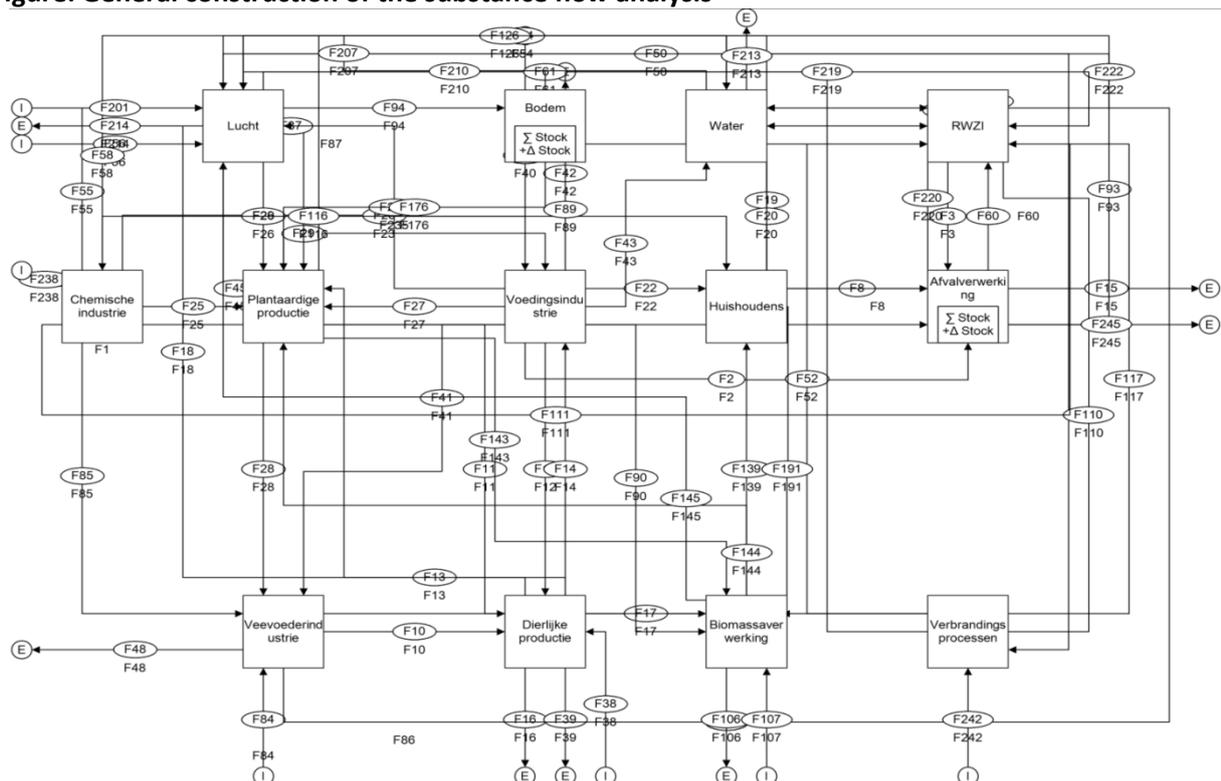
The results of the study further showed that both the chemical and the food industry are involved in a strong import and export of nutrients. The chemical industry imports the nutrients as raw materials for the production of fertilizers, which are afterwards exported. The interaction with the rest of the economy is rather limited and mainly takes place through the use of mineral fertilizers produced by the chemical industry and used by the crop production. The agri-food complex is also very important in terms of nutrient flows in Flanders. It is especially in this complex that environmental profits can be made. There is a potential for reducing the N-emissions of the animal husbandry (24 kton N) and the crop production (22 kton N). The emissions to water are mainly due the agri-food complex: 19 kton N from the crop production. Three other focus points are the NO_x-emissions of transport and energy, the N and P emissions of households and waste water treatment, as well as the loss of usable N from waste combustion. Important fluxes where a potential for recovery exists, are the annual flows of manure (133 kton N and 28 kton P), the organic biological waste from the food industry (22 kton N and 8 kton P), sludge from waste water treatment plants (4 kton N and 3 kton P), and the P-rich ashes from combustion installations (13 kton P).

The total N-import in all economic sectors comes to 1017 kton N and 115 kton P. The export of all Flemish economic sectors amounts to 655 kton N and 115 kton P.

A comparison of the Flemish substance flow analysis with Ott & Rechberger (2012) shows that Flanders imports 2 kg P more in animal feed than other EU-15 member states, but uses 2.4 kg P less per habitant in mineral fertilizers. In the EU-15 4.9 kg P/capita is used in animal feed, resulting in a production of 0.76 kg P/capita in meat and other products, while 4 kg P/capita of manure is produced. On the contrary, in Flanders, 6.9 kg P/capita is used in feed, for a production of 2.2 kg P/capita of meat products and 4.7 kg P/capita of manure.

The crop production gives in the EU-15 about 4.6 kg P in plant products (for food and feed), while 2.7 kg P/capita is used in P-rich mineral fertilizers. In Flanders, 3.9 kg P / capita is produced in crop products, for which only 0.23 kg P/capita in mineral fertilizers was used. This is due to the import of animal feed. A comparison of the food industry allows to conclude that 5.7 kg P/capita is imported in Flanders for the food and feed industry, whereas the export amounts to 3.94 kg P/capita. The domestic food consumption is 0.73 kg P/capita. The import and export outside the EU-15 amounted to 0.88 and 0.33 kg P/capita respectively. In addition, there is a food consumption of 0.9 kg P/capita in the EU-15.

Figure: General construction of the substance flow analysis



- o Read the full report '[Begroting van stikstof- en fosforstromen in Vlaanderen](#)' (Dutch report with English summary)
- o MIRA indicators: [Nitrogen flows](#) & [Phosphorus flows](#)
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