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IMPLEMENTATION OF THE ECOLOGICAL SCARCITY METHOD FOR THE RUSSIAN FEDERATION AND GERMANY

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ABSTRACT

The ecological scarcity method refers to Life Cycle Impact Assessment (LCIA) methods. The intent of the method is to evaluate different kinds of the environmental impact in the same units, eco-points. To do this it is necessary to have database of eco-factors (EF) values for the pollutant or resource consumption. Transformation rules advance the eco-factor calculation for different countries in the case if data for the direct calculation are missed. The paper provides results for definition of transformation rules between Switzerland, Japan, Germany and the Russian Federation, based on the example of chemical oxygen demand (COD).

INTRODUCTION

The Ecological Scarcity Method is one of the methods for impact assessment in LCA. It enables to express different environmental impacts in single score units, eco-points. Such results are handy for decision-makers in policy or enterprises to improve environmental management.

The main advantages of the method are ease of use, transparency and direct derivation from political targets (Frischknecht et al., 2010).

Another advantage of the Ecological Scarcity method is that the concept can be used to establish an ecological scarcity method valid for other nations or political entities. The Ecological Scarcity Method was developed in Switzerland. The first version was published in 1990. It has spread to several European countries in the 1990s, but the most widespread dissemination has been in Japan. First, was developed JEPIX (Environmental Policy Priorities Index for Japan) Method (Miyazaki et al., 2004) and later Ecological Scarcity Japan (Büssel et al., 2012).

The ecological scarcity method for Russia and Germany has been implemented by adaptation of the latest available version of Swiss eco-factor 2006 (Frischknecht et.al., 2009).

METHODS: THE ECOLOGICAL SCARCITY

The formula representation

In 2006 the main formula was updated in accordance to ISO 14044: Environmental management -- Life cycle assessment -- Requirements and guidelines (Finkbeiner et al., 2006).

The formula is used in the Ecological Scarcity Method– Eco-Factors 2006 (Frischknecht et.al., 2009):

$$Eco - factor = K \cdot \frac{1 \cdot EP}{F_n} \cdot \left(\frac{F}{F_k} \right)^2 \cdot c$$

K: Characterization factor — Fn: Normalization flow
F: Current flow — Fk: Critical flow
c : Constant (10^{12}/a) — EP: Eco-point

Critical and current flows are the key parts of the formula for eco-factors calculation. For each country the critical and actual flow are individual and stipulate national conditions.

Transformation rule concept

The transformation rule (TR) should advance the determination of the eco-factor for different nations if the direct calculation is not possible for some reason. Direct calculation is feasible if critical and actual flows are explicitly identified. TR can be obtained as a coefficient between known eco-factor for Switzerland or Japan, for example, and the one that needs to be calculated. In general, transformation rule should reflect the difference between the countries.

Swiss Eco-factors 2006 includes information on more than 600 substances for different impact categories. In some cases, these eco-factors can be directly applied for countries with similar environmental policy (Jungbluth et al., 2011), for example Germany. But it doesn't work with countries like the Russian Federation that has different driving forces for setting environmental goals and targets and level of social awareness. It is possible to get the trend between eco-factors for the same substance, but for diverse countries, by having data sets at least for several categories.

EXAMPLE OF DEFINING TR: COD

Chemical oxygen demand (COD) expresses the amount of oxygen necessary for oxidizing organic compounds in surface water or waste water. It makes COD a useful indicator of water quality.

The data regarding eco-factors for COD in Switzerland, Japan and Germany presented in the table below.

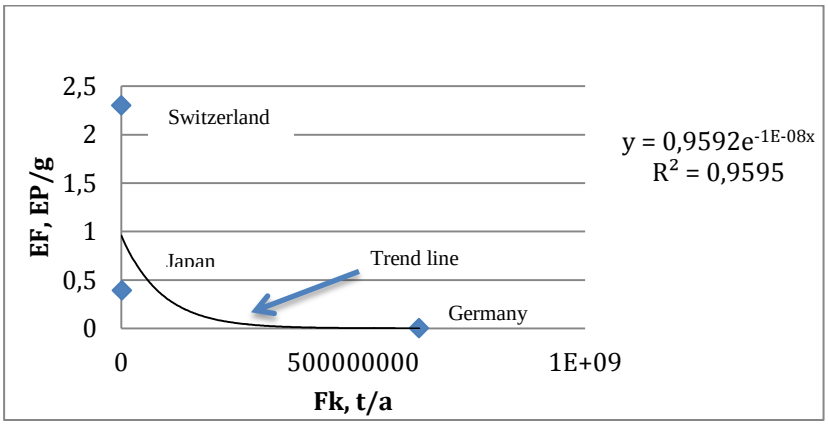
Table 1. Eco-factor for COD

Country	Actual flow, t/a	Critical flow, t/a	Weighting factor	Eco-factor, EP/g COD	Source
Switzerland	47,700	144,000	0.11	2.3	The Ecological Scarcity Method - Eco-Factors 2006 (Frischknecht et.al., 2009)
Germany	239,764,000	642,225,000	0.14	0.00058	own calculation
Japan	1,350,000	1,854,550	0.53	0.39	Ecological Scarcity Japan (Büssel et al., 2012)

For Russia it is possible to define critical flow for COD from the limitation according to the State Sanitary and Epidemiological Regulation of the Russian Federation. The critical flow is 3,339,000 t per year. Unfortunately, environmental statistical data doesn't give clear information that can lead to actual flow estimation. Thus, organic matter in surface water is addressed as substance with applicable political target. Nevertheless, calculation of Eco-factor seems to be impossible without actual flow.

Having the correlation between critical flow and eco-factors for Switzerland, Japan and Germany , eco-factor for Russia could be roughly estimated.

Figure 1. Correlation between critical flow (Fk) and eco-factor (EF).



The trend line helps to define the missing eco-factor. In case of the Russian Federation, it is 0.93 EP/g COD. Using the main formula of EcoScarcity, the actual flow and weighting can be estimated as well.

DISCUSSION

The estimation of eco-factors with the transformation rule is only one possibility in case of data gap. It should be seen as an intermediate solution. The available data must be carefully

analyzed and all assumptions should be clearly described, to make the TR transparent and understandable. The LCA case studies carried out with the "artificial" eco-factors should be interpreted correctly and do not lead to wrong conclusion.

In general, transformation rule should reflect the difference between the countries for example, geographical difference, population and economical grows, time frame, social aspects, etc.

CONCLUSIONS

Ecological Scarcity is policy oriented method and gives the feedback to the policy-makers for the future actions in the field of environmental regulation and monitoring. They should put the attention to the substance and substance categories for which part of the data are missing.

The application Ecological Scarcity for the Russian Federation aims to implement the LCIA method that is based on publicly available data for Russia and enforce the wider use of LCA tool as a step toward sustainable development.

For nations with high environmental standards and similar to Switzerland environmental policy, such as Germany, calculation of own eco-factors can be considered a regionalization and adjusts the EcoScarcity method widely using.

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