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ECOLOGICAL FOOTPRINT OF SWITZERLAND TECHNICAL REPORT

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Thomas von Stokar, Myriam Steinemann, Bettina Rüegge

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INFRAS

GERECHTIGKEITSGASSE 20
POSTFACH
CH-8039 ZÜRICH
t +41 1 205 95 95
f +41 1 205 95 99
ZUERICH@INFRAS.CH

MÜHLEMATTSTRASSE 45
CH-3007 BERN

WWW.INFRAS.CH

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1. INTRODUCTION

The Ecological Footprint measures how much of nature we possess and how much of nature we use. It is an indicator that translates the consumption of resources and of nature of the world, of a country, or a certain activity into a specific area of land. The Ecological Footprint assesses and quantifies the amount of human consumption that exceeds the regenerative capacity of the biosphere (Wackernagel 1999). It is based on the assumption that a certain land area is required to sustain the socio-economic system. This demand on area is balanced by the biocapacity of nature, e.g. nature's capacity to regenerate itself.

The Federal Office for Spatial Development (ARE), together with the Swiss Agency for Development and Cooperation (SDC), the Federal Office for the Environment (FOEN) and the Federal Statistical Office (FSO) launched a project for a national report of the Ecological Footprint of Switzerland.

The project has two goals:

- › Public awareness: The project shall prepare the Ecological Footprint of Switzerland in its country-specific context, starting with existing or ongoing research projects. The confederation aims to address and to sensitise people with an easy to read publication. This publication is not subject to discussion within this technical report.
- › Methodological innovation: The Swiss national report shall help to determine the differences that appear using international versus national statistics. This should generate methodological improvements, a better validity of the data and better reliability of the Ecological Footprint method. This technical report exclusively deals with this part of the project.

To determine the extent to which national data can help improving the Ecological Footprint, a reassessment of data is conducted. It will be up to the Global Footprint Network to decide whether national data will be included instead of the existing international data. In any case, comparability with other countries is a high priority. This means that Swiss-specific data will only be integrated into the calculation to the extent that it can still be compared to existing, international data.

2. METHODOLOGICAL APPROACH

2.1. BASIS

The Ecological Footprint is a complex indicator which includes roughly 4000 data points and 10'000 calculations. It is therefore of the highest relevance to retrace the exact Footprint calculation in detail. As a first step, INFRAS focuses on getting an overview of the applied methodology (incl. methodological changes), the data sources used, and definitions and system boundaries of the applied statistics.

2.2. ROUGH CHECK OF DATA

As a first step data underlying the Footprint calculation was checked roughly. It was obvious, that a comparative analysis of international and Swiss statistics for all required data points was not feasible and important categories should be prioritised in order to further investigate the categories identified. In order to identify the relevant categories, the following questions were used for clarification:

- › What does each category contribute to the Footprint?
- › Which products/inputs contribute the most to each category of the Footprint?

Based on these results, main categories and input parameters were checked in more detail.

2.3. DATA REASSESSMENT

Previously prioritised, relevant data was reassessed within this task. In order to enable a consistent data reassessment, the analysis was conducted with data from 2002. The comparison of national and international statistics was carried out according to a standardised pattern (refer to fact sheets for the Footprint components). This pattern permits a transparent description of possible differences of system boundaries or calculation methods.

The following methodological questions were clarified:

- › What is the reason behind the differences in international and national statistics? Are they based on different calculation methods, different demarcations, or different data sources?
- › Would the use of national statistics constrain the comparability between countries? Which national data is compatible with the Ecological Footprint's database, and which is not?
- › How would the introduction of national data influence the overall Footprint?

Additionally, time series and country comparisons were used to further check the plausibility of the data used. For this reason, time series between 1961 and 2002 were roughly analyzed and interpreted. For cross country comparisons the National Accounts of Austria, Denmark and Germany were compared to

the Swiss National Account. These countries were selected due to similar economic structures and/or similar population densities.

3. RESULTS

3.1. ROUGH CHECK OF DATA

The relevance of each category to the Footprint can be illustrated in a simple way based on the National Accounts. The Swiss Footprint for 2002 is composed as follows:

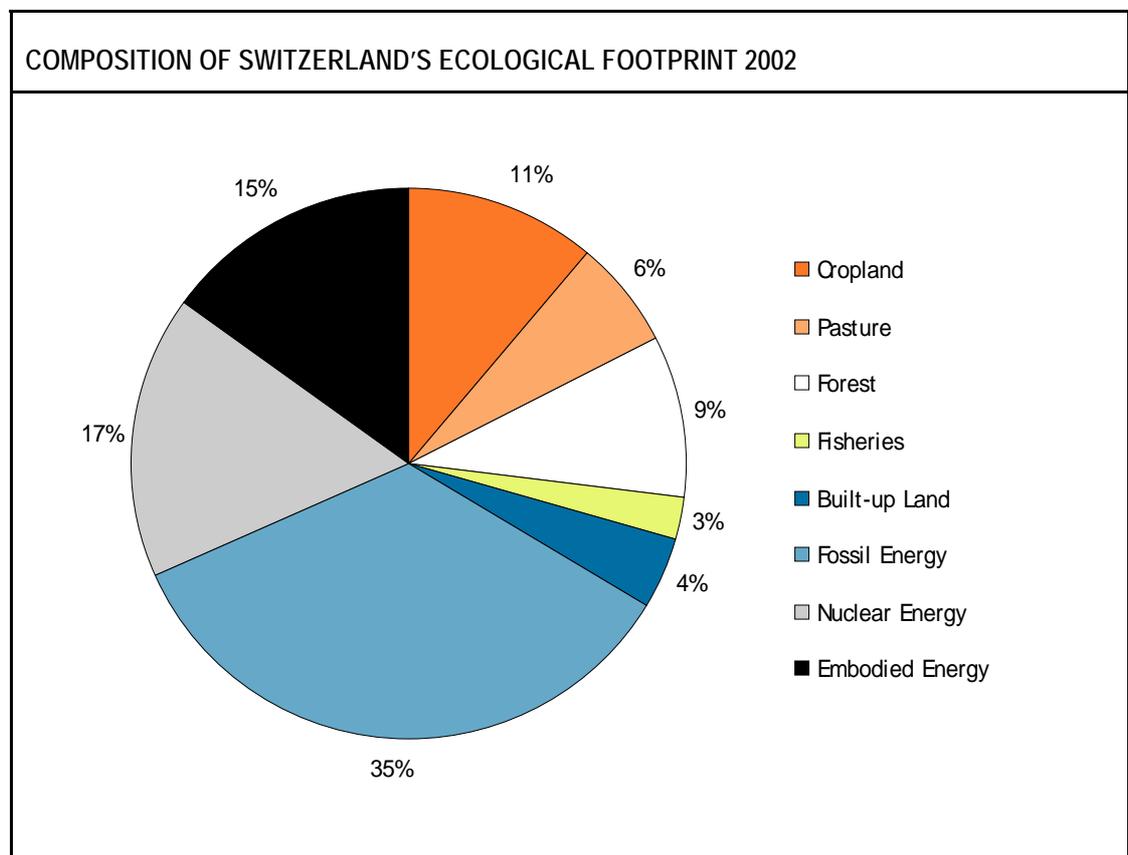


Figure 1 Composition of Switzerland's Ecological Footprint by land use categories. Energy demand accounts for 67% of the total Footprint. Reference: Global Footprint Network 2005a.

Energy clearly contributes the most to the total Footprint, followed by cropland. A prioritization of each category based on its contribution to the overall Footprint is done as follows:

CONTRIBUTION OF EACH CATEGORY TO THE ECOLOGICAL FOOTPRINT	
Contribution	Category
A: high (more than 15%)	Energy (Fossil Energy, Nuclear Energy and Embodied Energy)
B: medium (5-15%)	Cropland Forest Pasture
C: low (less than 5%)	Built-up Land Fisheries

Table 1 Contribution of land use categories to the Footprint.

Categories with high and medium contributions constitute 93% of the Ecological Footprint. These categories are most relevant for prioritization and consolidation and are therefore reassessed in further detail.

3.2. DATA REASSESSMENT

Under the data reassessment step, the products/inputs that have the most significant input on the respective category are extracted from Switzerland's National Footprint Account. The data reassessment will focus on the most relevant products within each category, since a complete check of all data points cannot be done within a reasonable amount of time (see Chapter 3.2). This chapter reflects the results of the data comparison between the statistical data used by the Footprint Network and the official Swiss statistical data.

3.2.1. ENERGY

The Footprint methodology differs between three components within the energy category: Fossil fuels, nuclear energy and embodied energy in trade.

Burning fossil fuel adds CO₂ to the atmosphere. The **Footprint of fossil fuels** is calculated by estimating the biologically productive area needed to sequester enough CO₂ to avoid an increase in atmospheric CO₂ concentration. Nuclear power is accounted in the same way as fossil fuel¹. Only data on nuclear power production but no data on import and export of nuclear energy is included. Trade in electricity will be included in an upcoming revision. **Embodied energy** is the energy used during a product's entire life cycle for manufacturing, transportation, product use and disposal. The Ecological Footprint Accounts calculate each country's net consumption by adding its imports to its production, and subtracting its exports (Global Footprint Network 2005b).

¹ For explanations regarding the Footprint calculation methodology please refer to the Annex of the Publication "Der ökologische Fussabdruck der Schweiz: Ein Beitrag zur Nachhaltigkeitsdiskussion" (available in German, French, Italian, and English).

Footprint relevance

Energy demand accounts for 67% of Switzerland's Ecological Footprint. The relevance for Switzerland's total Ecological Footprint is high. The 67% can be split further into the three above mentioned components: The Footprint of fossil fuels accounts for 35%, nuclear energy accounts for 17%, and embodied energy in trade accounts for 15% of Switzerland's total Ecological Footprint.

Data base

The following international data and Swiss data are compared:

- › Data used by the Global Footprint Network:
 - › CO₂ emissions data and nuclear energy production data are taken from the International Energy Agency (IEA). The IEA produces an annual statistical report on CO₂ emissions from fossil fuel combustion for more than 140 countries and regions. IEA data for Switzerland is provided by the Swiss organisation Carbura (Carbura Schweizerische Zentralstelle für Einfuhr flüssiger Treib- und Brennstoffe).
 - › Embodied energy in trade data: UN COMTRADE Trade Database.
- › Swiss data:
 - › CO₂ emissions data: There are two main data sources on CO₂ emissions in Switzerland, the data from the International Energy Agency and the Swiss Greenhouse Gas Inventory. The Swiss Greenhouse Gas Inventory is submitted annually under the UNFCCC.
 - › Swiss nuclear energy production data: Schweizerische Gesamtenergiestatistik 2002.
 - › Swiss embodied energy in trade data: National data on embodied energy is not available in Switzerland. Only the amounts of traded goods in tons could be compared. This data is taken from the Swiss Foreign Trade Statistics (Schweizerische Aussenhandelsstatistik 2002).

Data comparison

Footprint of fossil fuels (CO₂ emissions data): There are some methodical differences between IEA and Swiss Greenhouse Gas Inventory data. i.e., stock changes are not handled identically. IEA does not include stock changes in its calculations. According to Andreas Schellenberger, research associate at Federal Office of Energy, the deviation between IEA and Swiss GHG Inventory data used to amount to approximately 5 percent which is considered a normal deviation by the IEA. The Swiss Greenhouse Gas Inventory is at present undergoing methodical adjustments. Andreas Schellenberger therefore recalculated the difference between IEA and GHG Inventory data. The difference declined to approximately 2%. The uncertainty of Swiss GHG Inventory data itself is estimated to be approximately 3% (FOEN 2005).

Fact Sheet for data comparison				
Type of Area		Fossil Energy (CO ₂ Emissions)		
Most relevant data categories				
	Data source (int. and CH), incl. Interviews etc.	Emissions 2002 (Mt/CO₂/y)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	
Total CO ₂ emissions (sectoral approach)	Int. Data: IEA. Swiss Data: Switzerland's Greenhouse Gas Inventory 1990-2004. National Inventory Report 2006.	42.83	43.80	Difference amounts to 2.2% and is therefore in the range of the estimated 2% variance due to methodical discrepancies.

Table 1 Detailed results of data reassessment of the area type Energy (Fossil Energy).

Footprint of nuclear energy (production of nuclear energy data): Difference between international and Swiss data is approximately 1% (see Data Comparison Fact Sheet below).

Fact Sheet for data comparison				
Type of Area		Nuclear Energy		
Most relevant products in Switzerland				
	Data source (int. and CH), incl. Interviews etc.	Production 2002 (GJ/cap)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	
Production of Nuclear Energy	Int. Data: IEA. Swiss Data: Schweizerische Gesamtenergiestatistik 2002	38.70	39.09	Differences are not significant.

Table 2 Detailed results of data reassessment of the area type Energy (Nuclear Energy).

Embodied energy in trade data: The Footprint of embodied energy encloses approximately 600 categories of goods that are imported and/or exported. As there are no specific Swiss statistics regarding embodied energy available, only a check of the ten most relevant goods and good categories in terms of imported and exported tons was made (see Data Comparison Fact Sheet below).

The data reassessment revealed some inconsistencies regarding system boundaries. Where system boundaries are clearly defined (e.g. in the case of the category “passenger motor cars, other than buses” or in the category “aluminium and aluminium alloys, unwrought”), data is consistent. In some cases system boundaries are not identical or unclear. For example it is not self-explanatory which product categories are summarized in the categories “products of polymerization and copolymerization” or “electrical machinery and apparatus”. In these cases data comparison would require additional research which could not be done under this project.

While reassessing data, an inconsistency between data on the weights of traded products provided by national statistics offices and those used by Global Footprint Network was noticed. By examining this discrepancy, Global Footprint Network found out that an aggressive data cleaning algorithm was used to exclude poor data from the UN trade accounts. Global Footprint Network was re-estimating the weight of traded goods when the national prices of goods differed from average world prices by a factor of more than five. The idea behind the data cleaning algorithm was the following: If the amount within a category estimated using world average prices is more than five times off the one reported in physical units (e.g. tonnage), the world average price as the correct number was used and the physical amount was calculated using the world price. Therefore the data filtering for trade was relying too often on price rather than tonnage, leading to distortion in the embodied Footprint of imports and exports. This will be corrected for the 2006 Edition.

Fact Sheet for data comparison						
Type of Area	Embodied Energy in Trade					
Most relevant trade products						
	Data source (int. and CH), ind. Interviews etc.	Imports 2002 (t/yr)		Exports 2002 (t/yr)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	Int. Data	CH Data	
Products of polymerization and copolymerization	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	810'472	?	291'047	?	System boundaries are not clear.
Chemical products and preparations	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	1'037'232	?	333'572	?	System boundaries are not clear.
Passenger motor cars, other than buses	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	402'348	402'349	111'649	111'650	No differences.
Furniture	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	397'289	473'738	113'657	118'604	System boundaries are not clear.
Aluminium and aluminium alloys, unwrought	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	119'429	119'428	7'139	7'139	No differences.
Electrical machinery and apparatus	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	12'906	258'457	13'218	218'924	System boundaries are not clear.
Vitamins and provitamins	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	2'375	2'375	36'995	0	It could not be found out whether the difference in exports data derives from a methodical difference or is just a mistake.
Organic inorganic & heterocyclic compounds	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	100'624	?	37'954	?	System boundaries are not clear.
Nitrogen function compounds	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	139'644	?	41'330	?	System boundaries are not clear.
Medicaments	UN Comtrade Database, Schweizerische Aussenhandelsstatistik	45'133	46'192	69'896	50'229	System boundaries are not clear.

Table 3 Detailed results of data reassessment of Embodied Energy in Trade data.

Sensitivity analysis

No sensitivity analysis was conducted due to methodical differences and unclear system boundaries.

Comparison with other European countries

The use of Energy has also increased in all other of the examined European countries (Austria, Denmark, Germany). Austria and Switzerland have a lower Footprint of fossil and nuclear energy. This can be explained through the higher significance of hydropower within these two countries. Denmark produces half of its power in coal-fired power plants and that leads to a high Footprint of fossil energy. Austria and Denmark do not produce nuclear energy and therefore do not have a Footprint of nuclear energy, since import and export of nuclear energy is not yet included in the National Footprint Accounts. Embodied energy in traded goods is hardly comparable and suffers significant changes between the time series 1961 to 2002.

However, the plausibility check through cross country comparison shows that energy data seem to reflect the specific countries' circumstances.

Conclusion

To maintain international comparability, it is recommended to maintain international data. Global Footprint Network uses IEA statistics since the data for all nations both currently and in historical time are available in a standardized format. This allows the Global Footprint Network to calculate the energy Footprint across countries and years using a single set of tables and formulae.

As far as the aggressive data-cleaning algorithm for trade data is concerned, Global Footprint Network has decided to adjust this capping algorithm in the next revision of Ecological Footprint calculations at least for OECD nations (raising the trigger for the algorithm from a factor of five to a factor of 900). This means that Global Footprint Network will only catch and re-estimate data that was seriously mis-reported (e.g., reported in kg instead of tonnes).

A quick examination of the effects of removing this algorithm shows that, for some countries which import and export high value products, this change will lead to a visible correction to the total Footprint of nations. For Switzerland, the new algorithm would lead to a significant increase of the total Footprint from 4.7 gha/cap to 5.1 gha/cap (+9%). These differences can mostly be explained by net exports of medicaments and various pharmaceutical goods. The five traded goods which are most affected by the methodological change are listed in Table 4.

MOST IMPORTANT DIFFERENCES IN TRADED GOODS DUE TO METHODOLOGICAL CHANGES			
Traded goods	Gha/cap with 2005 Method (capping factor 5)	Gha/cap with 2006 Method (capping factor 900)	Differences (in gha/cap)
Medicaments	-0.20	-0.01	0.18
Nitrogen function compounds	-0.05	0.01	0.06
Organo inorganic & heterocyclic compounds	-0.03	0.01	0.04
Wood simply shaped or worked	0.00	0.02	0.02
Aldehyde, ketone, quinone function compounds	-0.01	0.01	0.02
Other	0.88	0.95	0.08
All traded goods	0.70	1.09	0.39

Table 4 Traded goods, which are most affected by the methodological change. Data from the year 2002 are used.

With the capping factor of 5 the amount of exported medicine was overestimated. With the new capping factor of 900 the exports of these goods are estimated to be much lower in terms of global hectares (and hence, the net import of embodied energy is bigger). Medicaments account for almost 50% of the differences in footprint between the former and the new algorithm.

Changes to the footprint per capita are displayed in Figure 2.

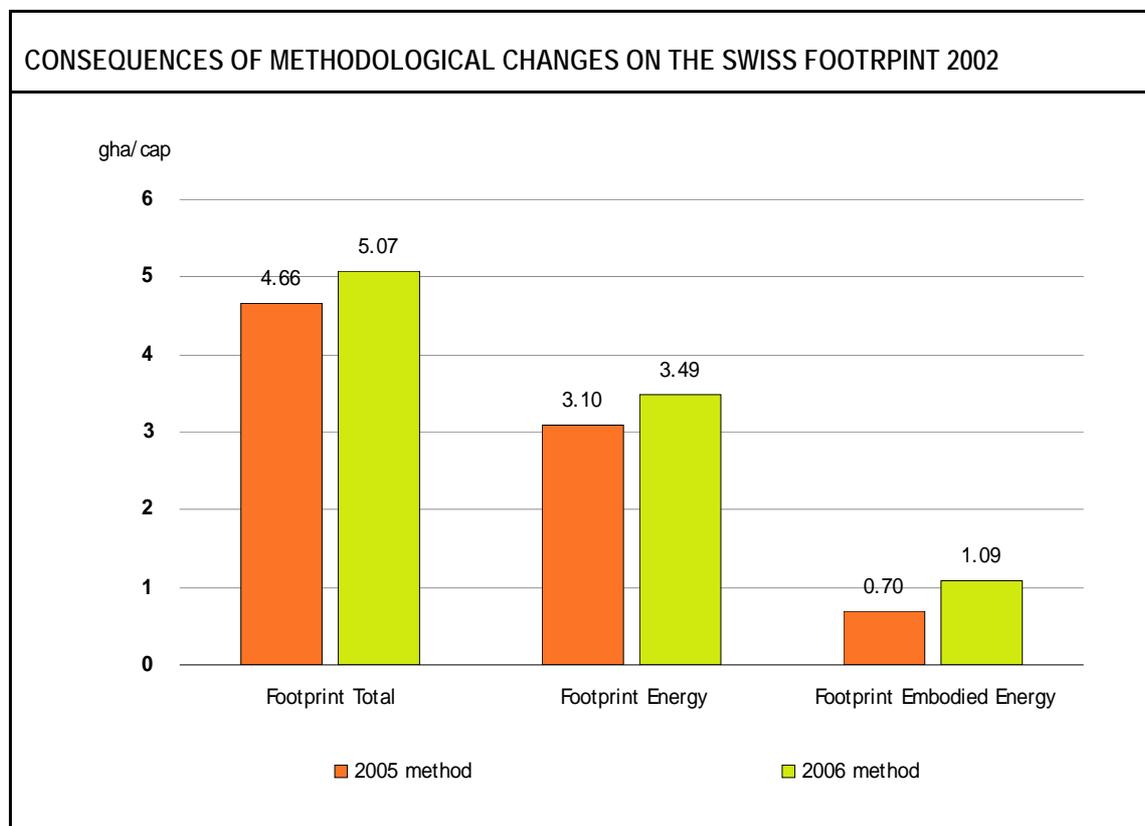


Figure 2 Consequences of methodological changes on the Swiss Footprint per capita (data 2002).

With these corrections the energy footprint will increase by almost 13%, the footprint from embodied energy in trade by even 55%!

3.2.2. CROPLAND

The Footprint of cropland includes cereals for human consumption, cotton, processed oils and fodder crops for livestock. The accounts include over 70 crops and 15 secondary products, and the quantity of each product allocated to feed, seed, waste, processing, and non-food uses (Global Footprint Network 2005b).

Footprint relevance

The category Cropland accounts for 11% of Switzerland's Ecological Footprint. Relevance for Switzerland's total Ecological Footprint is medium.

Data base

The following data is being compared:

- › Data used by the Global Footprint Network: FAO Food Balance Sheets Data.
- › Swiss data: SBV Schweizerischer Bauernverband (Swiss Farmer's Union): Statistische Erhebungen und Schätzungen; Schweizer Aussenhandelsstatistik 2002 (Swiss foreign trade statistic)

Data comparison

Only the major products in terms of their contribution to the Ecological Footprint are assessed in detail. These are wheat, barley, sunflower seed oil, sugar beets, maize and coffee. Details are displayed in the Data Comparison Fact Sheet.

Generally, international and Swiss data match well. Major differences arise due to the fact that statistical units are not always identical. FAO Food Balance Sheets data is always given in raw material equivalents. Swiss production data in the categories wheat, barley and maize is also displayed in raw material equivalents and differs only slightly from FAO data. Swiss grain imports and exports data is also given in raw material equivalents, but differs from FAO data. The difference might be explained by different methodical approaches for converting a certain amount of processed products into raw material equivalents. As far as coffee is concerned, Swiss imports and exports data is not provided in raw material equivalents but in tons of primary respective secondary (processed) coffee product. This is the reason for differences especially in the figures of exported coffee.

Fact Sheet for data comparison										
Type of Area	Cropland									
Most relevant products in Switzerland										
	Data source (int. and CH), incl. Interviews etc.	Production 2002 (t/yr)		Imports 2002 (t/yr)		Stock Changes 2002 (t/yr)		Exports 2002 (t/yr)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	
General										Swiss production data = gross production - loss. International imports and exports data (FAO Food Balance Sheets Data) includes primary products as well as secondary products (processed products). Secondary products are converted into raw material equivalents. Swiss imports and exports data for this category is also in raw material equivalents. Differences between international and Swiss data might be explained by different methodical approaches for converting processed products into raw material equivalents.
Wheat	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband	550'400	508'500	461'376	397'100	0	0	57'224	53'700	See above.
Barley	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband	254'900	247'200	139'348	137'600	1'949	0	55	2'100	See above.
Sunflowerseed Oil	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	7'200	7'366	40'537	40'537	0	0	594	594	
Sugar Beet	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband	1'407'910	1'407'910	12'937	12'937	0	0	0	0	
Maize	Int: FAO Food Balance Sheets, CH: SBV Schweizerischer Bauernverband	194'800	189'000	66'670	123'300	0	0	891	19'300	See above.
Coffee	Int: FAO Food Balance Sheets CH: Schweizer Aussenhandelsstatistik	0	0	76'790	72'211	0	0	33'012	13'115	International trade data in t raw material equivalents. Swiss data is not in raw material equivalents but in t primary resp. secondary coffee products. Coffee import: The difference between the different figures is relatively small due to reason that most of the coffee is imported as raw material. Coffee export: The difference between the different figures is higher due to the fact that most of the coffee is exported as a processed product.

Table 5 Detailed results of data reassessment of the area type Cropland.

Sensitivity analysis

A sensitivity analysis is only feasible when data is available in comparable statistical units. Therefore an analysis was only conducted for the categories wheat, barley, sunflower seed oil, sugar beet and maize, but not for coffee because of the above mentioned methodological differences. These five categories account for 44% of cropland footprint. If Swiss data was used for these categories, total Footprint in global hectares would decline from 33'447 to 33'307 (-0.4%). Total biocapacity would decline from 11'511'000 to 11'424'000 (-0.8%) global hectares. Differences are therefore very small.

Comparison with other European countries

The Footprint of cropland declines in all of the four examined European countries (Switzerland, Austria, Denmark, Germany). Switzerland's Footprint of cropland is 0.5 global hectares per capita whereas Denmark's Footprint is almost 1 global hectare. The difference can be explained by the higher demand of animal feed (based on crop products) in Denmark. The results of the four countries seem plausible.

Conclusion

Differences between FAO Food Balance Sheets data and Swiss data can mainly be explained by methodical differences. However, the results seem to be reasonable in general. Also in order to maintain international comparability, it is recommended to remain with FAO Food Balance Sheets data.

3.2.3. PASTURE

Grazing animals for meat, hides, wool, and milk requires grassland and pasture area. The Footprint of pasture is the demand of grassland and pasture area to produce animal products.

Footprint relevance

The category pasture accounts for 6% of Switzerland's Ecological Footprint. Therefore the relevance for Switzerland's total Ecological Footprint is medium.

Data base

The following data is assessed:

- › Data used by the Global Footprint Network: FAOSTAT Food Balance Sheet Data
- › Swiss data:
 - › SBV Schweizerischer Bauernverband 2003 (Swiss Farmer's Union): Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung.
 - › Schweizer Aussenhandelsstatistik 2002 (Swiss foreign trade statistics).

Data comparison

Production data generally matches very well. Trade data does not match due to the fact that Swiss trade data different to the FAO Food Balance Sheet Data are not expressed in raw material equivalents. Swiss dairy trade data could not be obtained in raw material equivalents. For further details please refer to the Data Comparison Fact Sheet below.

Fact Sheet for data comparison										
Type of Area	Pasture									
Most relevant products in Switzerland										
	Data source (int. and CH), incl. Interviews etc.	Production 2002 (t/yr)		Imports 2002 (t/yr)		Stock Changes 2002 (t/yr)		Exports 2002 (t/yr)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	
General										International trade data (FAO Food Balance Sheets Data) includes primary products as well as secondary products (processed products). Secondary products (e.g. bacon, ham) are converted into raw material equivalents. Swiss trade data compiled in this table also include processed meat (e.g. bacon and ham) but not as raw material equivalents.
Beef	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	139'588	139'587	12'124	11'826	0	0	3'767	2'164	See general remarks.
Pork	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	235'810	235'630	14'429	13'272	0	0	236	3'158	See also general remarks.
Milk	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	4'047'729	3'951'600	349'007	?	0	0	663'619	?	Swiss milk trade data could not be obtained in raw material equivalents.
Poultry	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	54'230	54'230	46'077	37'730	0	0	416	311	See general remarks.
Eggs	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	37'197	37'222	39'276	36'251	0	0	18	11	CH: Assumption that average egg weight is 55g
Mutton and Goat	Int: FAO Food Balance Sheets CH: SBV Schweizerischer Bauernverband, Schweizer Aussenhandelsstatistik	6'391	6'391	6'892	7'055	0	0	0	0	

Table 6 Detailed results of data reassessment of the area type Pasture.

Sensitivity analysis

A sensitivity analysis could only be partially conducted. Wherever a sensitivity analysis was applicable (e.g. for production data), differences between international and Swiss statistics were insignificant. If Swiss production data was used, total Footprint in global hectares would increase marginally from 33'447 to 33'448. Swiss trade data cannot be compared as the data is not provided in raw material equivalents.

Comparison with other European countries

The Footprint of pasture accounts for 6% of Switzerland's Ecological Footprint, but only for 3 to 4% in Austria, Denmark and Germany. Compared to other countries where animal feed is largely depending on crop products grass and hay feed is much more important in Switzerland. Taking into account the prevailing land use patterns in Switzerland, this result seems plausible.

Conclusion

Differences between FAO Food Balance Sheets data and Swiss data are mostly insignificant and can be explained mainly by methodical differences. To maintain international comparability, it is recommended to remain with FAO Food Balance Sheets data.

3.2.4. FISHERIES

The Footprint of fisheries includes eight categories of fish and aquatic animals and one category of aquatic plants. These nine categories subsume an additional forty-two species group.

Footprint relevance

The category fisheries accounts for 3% of Switzerland's Ecological Footprint. Relevance for Switzerland's total Ecological Footprint is low.

Data base

The following data were compared:

- › Data used by the Global Footprint Network: FAO Food Balance Sheet Data from 2001, as 2002 fisheries data was not released by FAOSTAT in time for the most recent calculation edition.
- › Swiss data: Data from FOEN (fish production and fish catch) and Schweizer Aussenhandelsstatistik 2002 (fish import and fish export data).

Data comparison

There are significant differences between FAO and Swiss data (please refer to Data Comparison Fact Sheet below). The differences can again be explained by the fact that Swiss trade data is not provided in raw material equivalents unlike FAO Food Balance Sheet Data. Furthermore, Swiss trade data is not classified into categories like "pelagic" and "demersal" fish but into different fish species. A data comparison at the level of the existing FAO categories would require additional efforts for categorizing and further research.

Fact Sheet for data comparison										
Type of Area	Fisheries									
Most relevant products in Switzerland										
	Data source (int. and CH), incl. Interviews etc.	Production 2002 (t/yr)		Imports 2002 (t/yr)		Stock Changes 2002 (t/yr)		Exports 2002 (t/yr)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	
General										Significant differences but data can not be compared. Swiss trade data is not provided in fish equivalents unlike FAO Food Balance Sheets data.
Pelagic Fish	Int data: FAO Food Balance Sheets CH data: Schweizer Aussenhandelsstatistik	0	0	63'659	759?	0		25?		Swiss trade data does not use the FAO classification pelagic fish (only different fish species).
Demersal Fish	Int data: FAO Food Balance Sheets CH data: Schweizer Aussenhandelsstatistik	0	0	10'135	?	0		2?		Swiss trade data does not use the FAO classification demersal fish (only different fish species).
Freshwater Fish	Int data: FAO Food Balance Sheets CH data: FCEN, Schweizer Aussenhandelsstatistik	2'850	3'299	30'001	9450?	0		107?		
Crustaceans	Int data: FAO Food Balance Sheets CH data: Schweizer Aussenhandelsstatistik	0	0	20'428	5031?	0		24	16?	
Marine Fish, Other	Int data: FAO Food Balance Sheets CH data: Schweizer Aussenhandelsstatistik	0	0	31'252	?	0		76?		

Table 7 Detailed results of data reassessment of the category Fisheries.

Sensitivity analysis

No sensitivity analysis could be conducted regarding the imports of fish due to different statistical categories. Only fish production data could be analyzed. Production data is however of minor importance for the total footprint from fisheries. Therefore the sensitivity analysis does not cover the most important components. If Swiss production data was used, Switzerland's Ecological Footprint for the component "Fish" would increase from 887'000 to 888'000 global hectares (+0.1%).

Comparison with other European countries

The Footprint of fisheries was declining between 1961 and 2002 in all of the four examined countries due to increased yields per area. According to the FAO Food Balance Sheets data, in difference to other countries the consumption of fish has actually declined in Switzerland over this period (in particular the consumption of pelagic and demersal fish). A substantial amount of additional research would be required to assess data on such a detailed level.

Conclusion

Differences between FAO Food Balance Sheets data and Swiss data can be explained by methodical differences. The decline in consumption of fish in Switzerland can not be conclusively explained and appears as an unusual result to the Global Footprint Network. To maintain international comparability and

since fisheries are of minor importance for the total Ecological Footprint, it is nevertheless recommended to remain with FAO Food Balance Sheets data.

3.2.5. FOREST

Primary and secondary forest products are included into the National Accounts. Roundwood and fuelwood are the primary products of the forest Footprint. Fuelwood includes charcoal, while roundwood is subsequently processed into four commodities: sawn wood, wood-based panels, paper and paperboard, and wood pulp.

Footprint relevance

The category forest accounts for 9% of Switzerland's Ecological Footprint. Therefore, the relevance for Switzerland's total Ecological Footprint is medium.

Data base

The following data is compared:

- › Data used by the Global Footprint Network: FAOSTAT data 2002.
- › Swiss data: BFS/FOEN 2004: Wald und Holz Jahrbuch 2004 (data from 2002).

Data comparison

The data comparison revealed some inconsistencies due to different system boundaries. Where system boundaries are clear, which is the case for the categories roundwood and sawnwood, the differences between international and Swiss data amount to maximally 10%. Differences between international and Swiss wood fuel trade data amount to 16%.

As far as the category wood-based panels is concerned, there are huge differences between FAOSTAT and Swiss fibreboard production data as these are based on approximations and estimations (for details, please refer to the Data Comparison Fact Sheet below). Swiss fibreboard trade data is given in tons and not in m³. It is not transparent how the weight of different classes of wood-based panels is converted into m³.

Fact Sheet for data comparison								
Type of Area		Forest						
Most relevant products in Switzerland								
	Data source (Int. and CH), incl. Interviews etc.	Production 2002 (m ³ /yr)		Imports 2002 (m ³ /yr)		Exports 2002 (m ³ /yr)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	Int. Data	CH Data	Int. Data	CH Data	
Roundwood	Int. Data: FACSTAT, CH Data: BFS FCEN: Wald und Holz Jahrbuch 2004	4'557'000	4'557'000	381'140	353'000	2'005'010	1'994'000	Differences are less than 10%.
Sawnwood	Int. Data: FACSTAT, CH Data: BFS FCEN: Wald und Holz Jahrbuch 2004	1'392'000	1'420'000	409'320	430'000	196'650	216'000	Swiss production numbers are estimated. Differences are less than 10%.
Wood-Based Panels	Int. Data: FACSTAT, CH Data: BFS FCEN: Wald und Holz Jahrbuch 2004	701'000	170'516	491'030	530'000	665'090	754'800	According to information by Mr. Zesiger, BFS production and export data for wood-based panels is prone to mistakes. There is only one manufacturer of flake-boards in Switzerland. Due to data protection he is not obliged to disclose his production and export data. The available data (Int. and CH data) are based on approximations and estimations. Swiss fibreboard trade data is given in t and not in m ³ . It is not clear how the weight of different classes of wood-based panels is converted into m ³ .
Wood Fuel	Int. Data: FACSTAT, CH Data: BFS FCEN: Wald und Holz Jahrbuch 2004, Schweizer Aussenhandelsstatistik	991'000	991'000	6'950	5'665	34'550	29'521	Production data identical. Differences in trades wood fuel are approximately 16%.

Table 8 Detailed results of data reassessment of the area type forest.

Sensitivity analysis

A sensitivity analysis is only feasible when data is available in comparable statistical units. This is only the case for the categories roundwood, sawnwood and wood fuel. Data on wood-based panels is based on rough estimations and is therefore not compared. If Swiss data was used in the categories roundwood, sawnwood and wood fuel, Switzerland's total Ecological Footprint would slightly increase from 33'447'000 global hectares to 33'457'000 global hectares (+0.03%).

Comparison with other European countries

The Footprint of forest and forest products per capita is twice as high in Austria and Denmark compared to Germany and Switzerland. Switzerland's Footprint of forest product has declined whereas Austria's Footprint increased between 1961 and 2002. Differences seem plausible and can be explained by the importance of wood firings in Austria and the active promotion of wood for energy use.

Conclusion

International and Swiss roundwood, sawnwood and wood fuel data generally match well. International and Swiss data on wood-based panels is based on approximations and estimations. It is unclear whether international or Swiss data is more reliable. It is therefore recommended to remain with FAOSTAT data.

3.2.6. BUILT-UP LAND

The Ecological Footprint assumes that human settlement and infrastructure most often occupy agriculturally fertile regions. Some of the settlement area is paved over; other areas are still bioproductive such as gardens or parks (Global Footprint Network 2005b).

According to Global Footprint Network, the current calculations for the Footprint of built-up land rely largely on data sets (such as CORINE and national statistical agency data) with incomplete or non-existent information on time trends. To approximate the change in built-up land Footprint and biocapacity over time, the accounts currently divide the total extent of built-up land for the data year (for Switzerland, the data that Global Footprint Network currently has, are for 1996) by the population in that data year. This gives a figure for per person use of built-up land in the data year. This per person figure is then multiplied by total population in all other years to estimate the total built-up land Footprint over time. Therefore changes in the Footprint of built-up land only reflect changes in population but no additional use of surfaces for built-up land (as it is the case in reality). Therefore the Footprint of built-up land remains unchanged over time at 0.04 hectares (data point for 1996).

Footprint relevance

Built-up area accounts for 4% of Switzerland's Ecological Footprint. The relevance for Switzerland's total Ecological Footprint can therefore be considered as low.²

Data base

The following data was assessed:

- › Data used by the Global Footprint Network: According to Justin Kitzes, Global Footprint Network, the Footprint Network used data for the year 1996 from a web page of the Swiss Federal Statistical Office, which is no longer valid.
- › Swiss data: Swiss Federal Statistical Office, Arealstatistik 1992/97.

² When considering the growing area used for settlement and infrastructure and – linked with this process – an increasing mobility and use of energy, the importance is not low anymore. These processes are however reflected in the energy sector.

Data comparison

Since Global Footprint Network used Swiss data from 1996, deviation between international and Swiss data is low (approximately 1.1%). For details, please refer to the Data Comparison Fact Sheet below.

Fact Sheet for data comparison				
Type of Area		Built-up Land		
	Data source (int. and CH), incl. Interviews etc.	2002 (1'000 ha)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
Built-up area		Int. Data	CH Data	
Land for Settlement and Infrastructure	Global Footprint Network: Swiss Arealstatistik. CH: Arealstatistik 92/97	282	279	

Table 9 Detailed results of data reassessment of the area type Built-up Land.

Sensitivity Analysis

If Swiss built-up area data was used, Switzerland's Ecological Footprint for the category "Built up area" would decline from 1'350'000 global hectares to 1'336'000 global hectares (-1%). The total Footprint of built-up land would remain unchanged at 4%.

Comparison with other European countries

In all of the four examined countries, the Footprint of built-up land accounts for 3 to 4% of the overall Ecological Footprint. Time trends can however not be compared due to the fact that in all four countries calculation is based on one single data point. The estimated hectares for built-up land increase fairly steadily, in line with population. A plausibility check could therefore not be made.

Conclusion

Since international data derives from a single data point (1996), it is recommended to use Swiss data, especially for time series.

Global Footprint Network already decided to use a more complete data set from Arealstatistik to replace the older data point for the 2006 Edition of the National Footprint Accounts.

3.2.7. LAND USE

Land use data are needed for cross checking the data from a top down approach (in addition to the prevailing bottom-up approaches in the six categories) and for estimating the available biocapacity.

Data base

The following data are compared:

- › Data used by the Global Footprint Network:
 - › Cropland: FAOSTAT databases on Land Use (category "Area Hary")
 - › Pasture: FAOSTAT databases on Land Use (category "Permanent Pasture")
 - › Inland Water: FAOSTAT databases on Land Use
 - › Forest: UN/FAO Temporal and Boreal Forest Resource Assessment (TBFRA)
 - › Unproductive Land: FAOSTAT databases on Land Use.
- › Swiss data: Swiss Federal Statistical Office, Arealstatistik 1992/97.

Data comparison

Data generally matches well unless there are some uncertainties about system boundaries. For details, please see the Data Comparison Fact Sheet below.

Good congruence between Swiss and Footprint data can be found in the following cases:

- › Total Area (Discrepancy less than 0.1%),
- › Total Water Area (Discrepancy 0),
- › Total Land Area (Discrepancy less than 0.1%),
- › Built-up Area (Discrepancy approximately 1.1%).

Less congruence between Swiss and Footprint data can be found in the following cases:

- › Forest (Discrepancy approximately 8%),
- › Unproductive Land (Discrepancy approximately 10%).

Data in the categories Cropland and Permanent Pasture cannot be compared directly, as the Swiss Arealstatistik makes no difference between crop and pasture land. Swiss statistics only differentiate between primary crop- and pasture land and marginal crop- and pasture land.

Fact Sheet for data comparison				
Type of Area	Land use			
	Data source (int. and CH), incl. Interviews etc.	2002 (1'000 ha)		Qualitative Explanation of Differences (e.g. other classification). Are the differences significant?
		Int. Data	CH Data	
Total Area	Global Footprint Network: Arealstatistik CH: Arealstatistik 92/97	4'129	4'128	Differences insignificant.
Total Water Area	Global Footprint Network: FAOSTAT databases on Land Use CH: Arealstatistik 92/97	174	174	No differences.
Total Land Area	Global Footprint Network: Arealstatistik CH: Arealstatistik 92/97	3'955	3'954	Differences insignificant.
Cropland	Global Footprint Network: FAOSTAT databases on Land Use (category "Area Hary") CH: Arealstatistik 92/97	433	480	Footprint makes a difference between primary and marginal cropland. It seems that the Arealstatistik Codes 81 (Primary crop and pasture land) and 82 (Marginal crop and pasture land) were added and the sum was divided into 2 to get the figures for primary respective marginal cropland. The category "Cropland" is the sum of both figures.
Forest	Global Footprint Network: UN/FAO Temporal and Boreal Forest Resource Assessment (TBFRA) CH: Arealstatistik 92/97	1'173	1'272	TBFRA system boundaries are not clear.
Permanent Pasture	Global Footprint Network: FAOSTAT databases on Land Use (category "Permanent Pasture") CH: Arealstatistik 92/97	1'092	1'045	Footprint makes a difference between primary and marginal cropland. It seems that the Arealstatistik Codes 81 (Primary crop and pasture land) and 82 (Marginal crop and pasture land) were added and the sum was divided into 2 to get the figures for primary respective marginal cropland.
Built	Global Footprint Network: Arealstatistik CH: Arealstatistik 92/97	282	279	Differences of minor significance.
Unused low-productivity Land	Global Footprint Network: Arealstatistik CH: Arealstatistik 92/97	0	0	No differences.
Unproductive Land	Global Footprint Network: FAOSTAT databases on Land Use CH: Arealstatistik 92/97	975	878	FAOSTAT system boundaries are not clear.

Table 10 Detailed results of data reassessment of the category Land Use (relevant for calculation of biocapacity).

Sensitivity analysis

If Swiss land use data was used, Switzerland's total biocapacity would increase from 11'511'000 global hectares to 11'716'000 global hectares (+1.8%). On the other hand, the Footprint per capita would de-

crease from 4.66 to 4.64 global hectares due to the fact that less area is needed for built-up land.

Comparison with trends in other European countries

Land use data was not compared with data from other countries (no relevance for plausibility check).

Conclusion

Global Footprint Network refers to outdated data. It is recommended to use Swiss data from the Swiss Federal Statistical Office (Arealstatistik). Global Footprint Network already decided to use a more complete data set from Arealstatistik to replace the older data point for the 2006 Edition of the National Footprint Accounts.

4. CONCLUSION

International and Swiss input data for the year 2002 generally matches well. Data discrepancies within the categories Cropland, Pasture and Fisheries are mostly attributed to methodical differences. A quantification of discrepancies between Swiss and international data on an aggregated level was therefore not feasible. This would require additional research, methodological adjustments and conversions. Data discrepancies within the categories Built-up Land and Land Use can easily be adjusted. As far as Fossil Energy is concerned, differences are in the range of 2%. To guarantee international comparability it is justified to remain with IEA data as done by Global Footprint Network. A deepened data assessment for the category Embodied Energy would require additional research.

The plausibility check that was done by analyzing time series and comparing Swiss and international showed that data are plausible in most of the categories. Inconsistencies or implausible data can be found in the categories fisheries (methodological switch) and built-up land (lack of meaningful time series). These two categories are however of minor importance. Inconsistencies do therefore not lead to wrong estimations and erroneous interpretation of the general Footprint figures.

The collaboration between Global Footprint Network and INFRAS highlighted some ambiguities in the calculations in the National Footprint Accounts. Main ambiguities can be found in the field of embodied energy. Thanks to this collaboration methodological difficulties will be cleared in the next revision. This revision will lead to visible differences in the National Footprint Accounts, especially in countries importing and exporting products at much higher prices than world price.

Additionally, Global Footprint Network has been able to use this analysis to generate input for the ongoing process of creating handbook for the National Footprint Accounts and for adapting the 2006 Edition of the National Accounts.

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