MIPS as a tool for analysing food chains sustainability

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Abstract: *Nutrition is one of the most demanding area of need in terms of natural resource consumption. The following paper introduces a material-flow based methodology, MIPS (Material Input per Service Unit), for sustainability assessment of food. Two different investigations, concerning supply and demand side of nutrition, compose the study. In the first part we analysed the value chain of three Italian foodstuffs (pasta, rice, orange juice) and calculated the material intensity along the life cycle. These results were used in the second part, joined with data from the literature, for quantifying the natural resource consumption of 25 European diets. We argue that MIPS is a feasible assessment tool for enhancing sustainability in agro-food systems and revealing the contribution of each life cycle phase in the total impact. Our findings show farming phase being crucial in rice and natural orange juice production. It contributes for around 80% of the total material requirements of these crops. Instead, in pasta and concentrated orange juice industrial processing has a bigger weight. The comparison between organic and conventional rice shows that exists a trade-off in the use of biotic (renewable) and abiotic (no renewable) resources. Concerning the diets analysis, for each country we quantified the natural resources consumption due to nutrition and the average material intensity of a unit of generic food. These values are compared with the composition of diets in the different countries. Consistently with other studies, MIPS proved the stronger impact for diets with higher intakes of meat and animal products.*

Keywords: *MIPS, nutrition, value chains, resource consumption, sustainability, Life Cycle Assessment, foodstuffs.*

Introduction

Sustainable agriculture has become a relevant issue since the intensification of agricultural practices has substantially increased fertilizers and other intermediates employment, provoking a severe environmental impact. The European agricultural sector is also responsible for 70% of the total water use and contributing to the soil fertility depletion (De Fraiture et al., 2001). Modern agriculture has got completely hooked on agro-industry, requiring higher and higher quantities of energy and materials, in order to maintain a high production output. However, the depletion of natural resources is currently clearly visible, and worsened by the drastic population growth. Until the 2050 the world population will be increased up to 9 Billion people and the derived demand for food will call agriculture for huge challenges (Baedeker et al., 2008). “Nutrition” is one of the most material demanding areas of need, accounting 20% of the total natural resource consumption of German economy (see e.g. Rithoff et al. 2009). In order to reduce the material requirements linked to this human activity, a twofold effort is necessary. Considering the supply side, sustainable management tools for enhancing resource productivity should be implemented at company and chain level. On the consumers’ side, a better awareness of the ecological consequences of the consumption habits could help in turning the system into more sustainable patterns.

The MIPS indicator can focus both on micro-economic level (taking data from a single enterprise) and on macro-economic level, using average data from different sources and national statistics. The following paper introduces two MIPS applications: the first one focus on three foodstuffs’ value chain, using specific data from LCA (Life Cycle Assessment) studies; the second one concerns the natural resource consumption due to the food intakes of 25 European countries, using mostly national statistics. The scope of the study was to identify which elements are more responsible for the material requirement of the foodstuffs, and compare organic vs. conventional farming practices.

Moreover, we wanted to test the MIPS methodology as a tool for sustainability assessment in two different contexts.

MIPS methodology, assumptions and system boundary of the study are illustrated in the following chapter. The investigation on the value chains follows. Using the material input approach we outlined the more significant phases in terms of resource consumption, indentifying potentials for impact reduction. We used these results in the second part for an evaluation of the resource consumption of diets in European countries. For this purpose we used also other figures on material intensities from the literature. Conclusions point out some statements about strategies for the relieving of the environmental impact due to food production and facilitate the transition toward sustainability.

Methods

The sustainability promotion needs appropriate indicators. MIPS, Material Input per Service Unit (MI/S), is a measure for assessing and comparing the ecological pressure of different products or services. MIPS accounts the *"ecological rucksacks",* that is the sum of natural resources moved away from their original place in the ecosphere during the whole life-cycle of a certain raw material, product or activity. As it is a cradle to grave inventory, it also includes indirect natural resource use (Ritthoff et al., 2002). Different levels of analysis are possible using MIPS-based indicators. Resource management optimization and eco-efficiency promoting in companies, monitoring households' consumption or balancing the resource use of national economies are the most common ones. The MIPS approach does not provide as detailed information as LCA methodology, but the methodology is applicable with lower efforts in terms of time and costs. The results are easy to understand also for non-experts and alternatives can be compared on the base of their "ecological cost" (Schmidt-Bleek, 2008).

According to the model developed by the Wuppertal Institute (Ritthoff et al., 2002)., the material requirements of a product or service are calculated separately for five categories of material input (MI): abiotic (or non-renewable resources like mineral row materials, fossil energy carriers, soil excavations); biotic (or renewable resources from agriculture and silviculture); earth movement in agriculture and silviculture (mechanical earth movement), water (surface, ground and deep ground water) and air (the quantity of oxygen combusted that reflect the amount of carbon dioxide formed); also erosion can be calculated separately. Material requirements of materials, fuels, energy carriers and products are expressed in mass unit. These MI coefficients are the ratio between the quantity (in mass units) of natural resources used and the quantity (mass) of product obtained. Our calculations of MIPS values for foodstuffs and European food consumption are based on the use of these coefficients, already available in the literature (www.mips-online.info). They are not specific for Italy but most of them have been calculated for Germany. The applicability of these figures is possible since industrial processes are similar in different countries and to a large extend do not depend on environmental conditions.

The most controversially discussed aspect of the MIPS-concept is probably the link between the mass flow of resources and the environmental impacts caused by it. The traditional approach of environmental policy focused rather on the impact of hazardous substances in the output flows than on the material flow input, considering also the possibility of material recycling and the treatment of waste and emissions. Nevertheless, the importance of input mass flows and the necessity of a reduction of these amounts are evident. The costs of these treatments, both in economic and ecological terms, and the impossibility of a complete recycling of materials can prove it. Moreover, the specific impact of substances is often unknown and the amount of materials moved from their original location can instead be considered a proxi measure for the potential environmental impact.

In the first part of the study we used the MIPS approach for investigating the ecological rucksack of three Italian foodstuffs along their supply chains: pasta, rice (milled and parboiled from conventional farming, milled from organic farming), and citrus-based products (oranges, orange natural juice and orange concentrated juice). This choice is basically motivated by the availability of LCA studies and by the relevance of those foodstuffs in the Italian agro-food system. Rice is a typical crop of Northern

Italy and 50% of the European rice is from this area (Blengini, 2009). Pasta is one of the most exported product and consumed by 98.9% of the Italian people (Ismea, 2008). Within the national domestic purchase for fruit, orange is the first one and it is a key product for Southern Italy economy (Ismea, 2008).

The main source of data where six LCA studies: Bevilacqua et al. (2007 and 2001), Della Corte et al. (2003) for pasta, Blengini et al. (2009) for milled and parboiled rice, Mandelli et al. (2005) for organic rice, Beccali et al. (2009) for citrus-based products. We assumed the same purchase conditions for all the foodstuffs and the same incidence of the product in the trip to the retailers. Soil erosion statistics are not available for different crops and for Italy. We applied to the three crops (wheat, rice and orange grove) the estimation of 10 t/ha*year for Italian erosion due to agricultural use published by National Statistical Agency in 2003 (ISTAT, 2003). The system boundary includes the production and transportation of the chemicals, other inputs for agriculture and packaging materials (Fig 1). The travel from retailers to home and the cooking of the meal is also into the analysis, as well as the transport of the packaging materials. The impact of infrastructures, capital goods and waste management was instead neglected. We chose the service unit of 1 kg of food, thus MIPS results are expressed as kg of resources for kg of food, or material intensities.

According to MIPS methodology, the interpretation of results must consider separately the categories of water and air. Abiotic materials, biotic materials and erosion can instead be summed together for a common interpretation. The derived indicator is the Total Material Requirement (TMR). It is also used in national economies accounting and it expresses the total use of materials (Ritthoff et al., 2002).

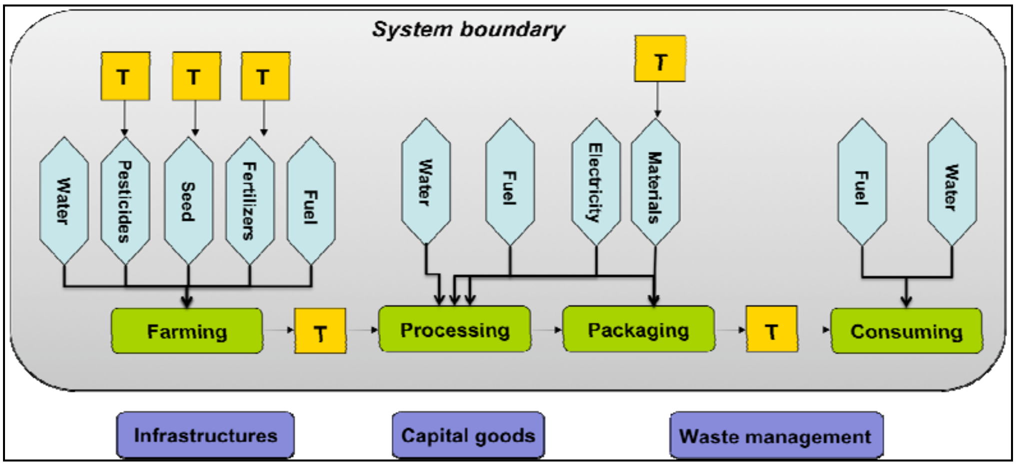

Figure 1. System boundaries for MIPS calculation of foodstuffs. "T" stands for transport process.

In the second part of the study we evaluated the natural resource consumption due to nutrition in different diets. We took into account the consumption of 18 foodstuffs in 25 European countries and the material intensities of these foodstuffs, that is the amount of raw materials used to produce a mass unit of food or agricultural product. Data on food consumption of European Union's countries are from the Eurostat report "From farm to fork" (Eurostat, 2008). Most of the data refers to gross human apparent consumption of the year 2007. The latest year available has been used to replace data that were not available for this year. Some single figures missing from Eurostat dataset were replaced with data from FAO Statistics on food consumption (www.faostat.fao.org). Concerning the material intensity of foodstuffs, we used our results on wheat (used for pasta MIPS calculation), rice and orange juice. Other figures are from the literature (Kauppinen et al., 2008; Ritthoff et al., 2009) and some values have been estimated by the authors on the base of similar food categories already existent (Mancini et al., 2009). We used the same material intensities for every country, as no specific data were available. This means that the wide variability of environmental, climatic conditions and specific agronomic techniques and processes could not be taken into account. Moreover, the cooking or preparation of the food at home, the question if they are domestically produced or imported were not included in this analysis. However, the same methodology proposed here can be used with specific national data once they will be available, in order to have a more accurate assessment.

Results

Material intensity along the value chains

Results for pasta

For MIPS calculation of pasta we used average data from three different LCA surveys (Bevilacqua et al., 2001; Bevilacqua et al., 2007; Della Corte et al., 2003). We considered only conventional durum wheat cultivation, with nitrogenous and phosphorous fertilization and pesticides treatments.. Irrigation is usually not necessary for durum wheat cultivation, except in case of extraordinary drought. Therefore, we excluded it from the MIPS calculation. The average yield of the three studies is 5678 kg/ha; for the accounting of earth movements in agriculture we assumed a maximum depth of ploughing of 30 cm and an average soil density of 1300 kg/m^3 (Bonciarelli, 1999). The estimated distance for transporting chemicals, other inputs for agriculture and materials for packaging is 150 km; the distance between milling plant and the pasta factory is 50 km; the distribution of final product to the shopping centre at a national level covers on average 400 km. The domestic consumption phase includes the travel for purchasing (30 km the round trip) and the incidence of pasta in the total expense (1%).

Table 1 presents the material intensity results of durum wheat and pasta and Fig. 2 shows the contribution of different phases of the supply chain. The TMR results (sum of abiotic, biotic and erosion) are 4.35 kg/kg for durum wheat and 9.32 kg/kg for pasta. In pasta production the contribution of electricity and fuels is relevant, taking 74.9% of abiotic row materials, 67.7% of water and 47% of air. Pesticides are responsible for 19.4% of the water use, while cooking takes only 6%. Regarding the air category, cooking contributes for 20%, transport and diesel for field operations 12% and 9.7% of the total consumption.

Table 1. Material intensity of conventional durum wheat and pasta

Material intensity (kg/kg)	Abiotic	Biotic	Water	Air	Erosion	Soil	TMR
Durum wheat	0.34	2.13	30.8	0.29	1.88	732	4.35
Pasta	3.95	2.86	179	1.63	2.51	981	9.32

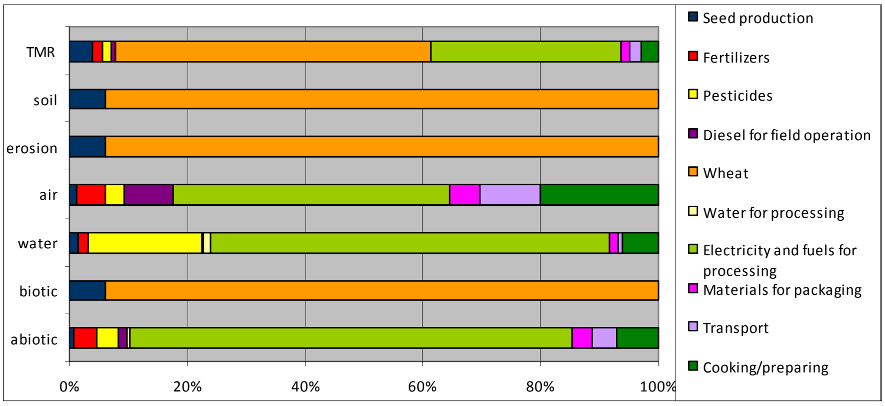

Figure 2. Composition of the material intensity of pasta

Results for rice

Information about rice from conventional agriculture (milled and parboiled) is from Blengini et al. 2008. This survey regards a representative farm in the Vercelli district in the North-West of Italy; this area provides 33% of national rice production. The average yield of paddy rice is 7040 kg/ha. Nitrogenous, phosphorous, potassic fertilization and pest treatments are employed in the conventional rice farming practice. Earth movements include tilling, ploughing and the maintenance of water canals; irrigation is based on the network of canals where water flows without the use of any pumping systems. The annual water consumption for irrigation is 19800 m^3/ha. Fuel consumption for field operation is from ENEMA (National Agency for Agriculture Mechanization). All the transports are included in the system. We assumed a local distribution to the retailers with an average distance of 200 km. Parboiled rice needs a special treatment after the drying of paddy rice. It consists of boiling, soaking, steaming and drying again. The packaging of milled and parboiled rice is made of polyethylene bag and an external carton box.

Data on organic rice (Mandelli et al., 2005) refer to a specific farm, in the area of Milan. The breeding activity of the farm provides manure and slurry for the fertilization; mustard seeds are sowed before rice for improving the chemical characteristics of the soil. The yield of paddy rice is 5000 kg/ha and the water for irrigation is 2500 m^3/ha, according to Mandelli. The organic rice is packed in a cotton bag and an internal polyethylene film.

Results for TMR of rice are 8.91 kg/kg for milled one, 9.43 kg/kg for parboiled and 9.04 kg/kg for organic one (table 2). For the three kinds of rice, more than 70% of TMR is due to farming (Fig. 3,4,5). In conventional rice (milled and parboiled) the impact of fertilizers is relevant for the category of abiotic resources (40% and 34%) and irrigation is responsible for almost the total consumption of water. Transports are also quite important for the consumption of air (28% and 21% of the total). Electricity affects more parboiled rice, which has higher material intensities also in absolute terms (in the categories of abiotic, air and water). Concerning the organic rice, the TMR is not lower than the conventional ones (8.91 kg/kg). In spite of a minor consumption of abiotic resources, in which packaging materials and electricity are contributing more, biotic resources and erosion contributes to a higher TMR. This result is explained by the minor yield of organic rice, which implies a major use of the soil and consequently a higher value of erosion. The consumption of biotic resources, bigger than in conventional rice, is due to the use of mustard seed, the cotton bag for packaging and the major amount of seeds for hectare that is required (200 kg/ha vs. 120 kg/ha of conventional one). Therefore organic farming, substituting the agrochemical, implies a major use of biomass and renewable resources at the expense of no renewable ones; the same is for the cotton packaging in the place of plastic made bag.

Air and water consumption are lower in organic rice and affected more by packaging materials than transport and electricity. In the organic rice the impact of cooking phase is especially relevant in the air category (43.5%) and in the abiotic one (11.6%).

Table 2. Material intensity of rice.

Material intensity (kg/kg)	Abiotic	Biotic	Water	Air	Erosion	Soil	TMR
Milled conventional rice	2.68	3.84	4809	1.28	2.40	2589	8.91
Parboiled conventional rice	3.20	3.84	4828	1.70	2.40	2589	9.43
Organic rice	1.28	4.17	1462	0.76	3.58	3866	9.04

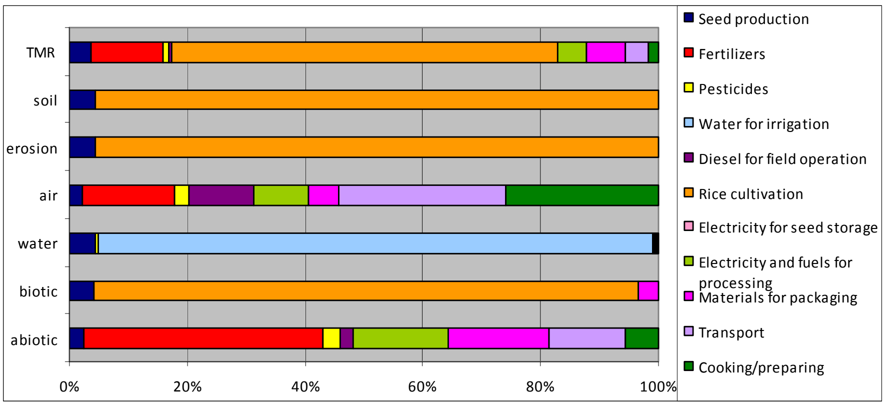

Figure 3. Composition of the material intensity of milled rice.

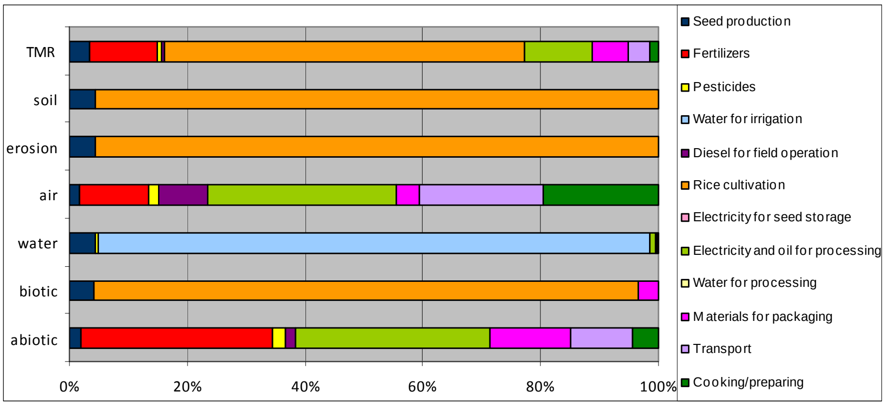

Figure 4. Composition of the material intensity of parboiled rice.

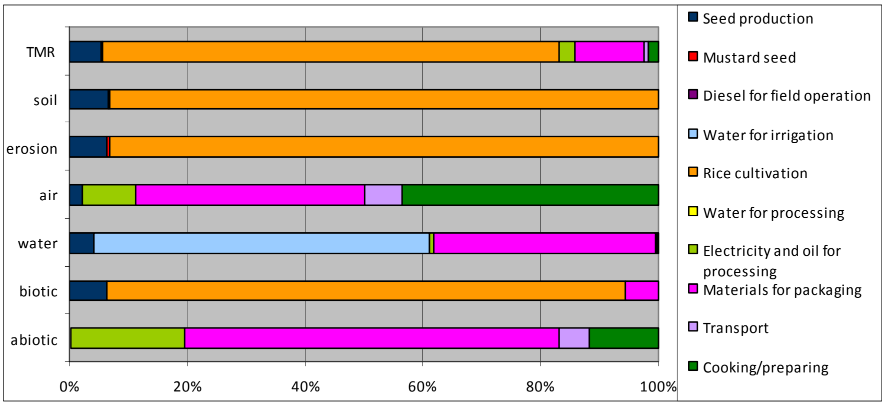

Figure 5. Composition of the material intensity of organic rice.

Results for citrus based products

We applied the MIPS methodology to the production of oranges, natural juice (NJ) and concentrated juice (CJ) from oranges, based on Beccali et al. (2009) LCA information. The area of cultivation is Sicily and the manufacturing process of citrus-derived products regards a Sicilian factory with regional representative size. In the conventional farming of citrus planting nitrogenous, phosphorous and potassic nutrients are applied and annual water consumption for irrigation is about 4200 t/ha. We assumed the deepest ploughing being 80 cm before the planting, one time in 25 years (the life span of the grove) and a soil density of 1350 kg/m^3. We neglected the nursery production.The average yield is 25 t/ha of oranges. The manufacturing process of NJ is composed by selection and washing, primary extraction, refining, pasteurization and cooling, refrigeration and packaging. CJ needs an additional treatment for reducing the amount of water. One kilogram of oranges provides 0.142 kg of NJ and 0.028 kg of CJ. We assumed average transport distances of 150 km from the field to processing and 500 km for distributing. The products are packed into polyethylene bags.

Material intensity results are obviously much more higher for CJ, due to the minor yield of juice of a factor of five (35 kg of oranges for 1 kg of CJ, 7 kg of oranges for 1 kg of NJ). However, we didn't consider a following dilution that can be done domestically or industrially, when CJ is used in further processing. Abiotic resource consumption is especially higher in CJ, (Fig. 7) due to the electricity and fuels for industrial processing (82%) while fertilizers are responsible for about 50% of the abiotic resource consumption in NJ (Fig. 6). Materials for packaging contribute overall in the air category (82% in NJ and 40% in CJ), while water consumption depends most on irrigation.

Table 3. Material intensity of citrus based product.

Material intensity (kg/kg)	Abiotic	Biotic	Water	Air	Erosion	Soil	TMR
Oranges	0.20	1.00	181	0.11	0.40	17.28	1.60
Orange natural juice	2.17	7.06	1302	6.73	2.82	121.9	12.05
Orange concentrated juice	35.56	35.27	6901	13.92	14.1	609.5	84.94

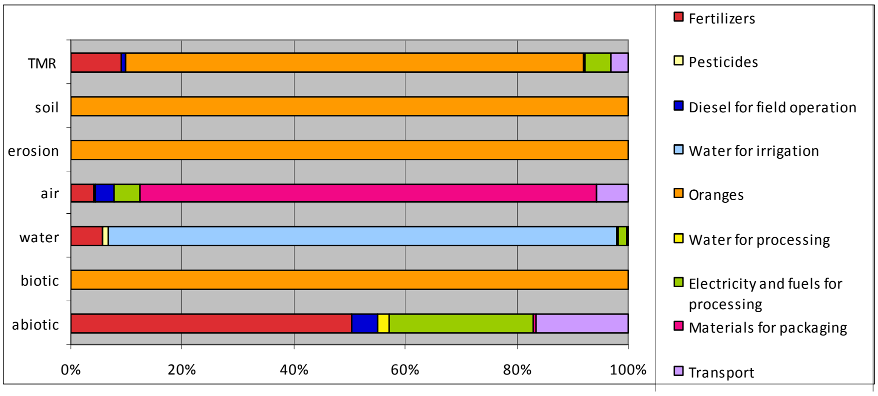

Figure 6. Composition of the material intensity of natural orange juice.

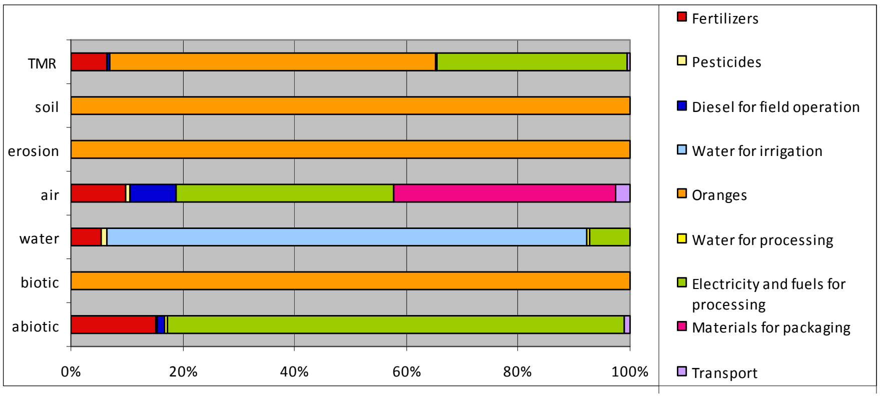

Figure 7. Composition of the material intensity of concentrated orange juice.

Material Requirements of European diets

In table 4 is the list of foodstuffs considered in the assessment of Europen diets' natural resource consumption, with the corresponding material intensity values and data sources. For each country, the material intensities of foodstuffs were multiplied with the amount consumed, in order to get the total material input for nutrition and the relative share for each category of food.

Table 4. Material intensities of the considered foodstuffs.

Foodstuffs	ABIOTIC	BIOTIC	WATER	SOIL	EROSION	AIR
Wheat (c)	0.34	2.13	30.8	732	1.88	0.29
Rice (c)	2.57	3.84	4809	2589	2.40	0.95
Potatoes (a)	0.10	1.06	0.39	112.5	0.22	0.01
Vegetable oils & fats (a)	4.50	3.72	70.5	5490	11.49	0.98
Sugar (a)	8.58	12.63	53.7	542.2	1.15	4.70
Apples (b)	1.00	1.00	7.00	93	0.32	0.01
Oranges (c)	0.20	1.00	181	17.28	0.40	0.11
Pears (b)	1.00	1.00	7.00	93.0	0.32	0.01
Tomatoes (b)	8.00	1.00	793	36.0	0.01	4.00
Cattle (a)	10.9	26.39	451	3329	11.1	2.81
Poultry (a)	6.44	5.93	235	3405	5.90	1.63
Pigs (a)	2.57	6.89	62.33	2967	6.51	1.01
Sheeps and goats (a)	10.9	26.4	451	3329	11.1	2.81
Fish & seefood (a)	2.80	4.70	271	148	0.17	0.83
Drinking milk (a)	0.15	2.75	4.68	259.5	0.89	0.03
Butter (a)	3.42	56.9	105.7	5366	18.4	0.79
Cheese (a)	0.84	14.2	25.51	1344	4.62	0.20
Eggs (a)	1.15	1.98	28.56	605.9	0.93	0.25

(a) Ritthoff et al. (2009); (b) Kotakorpi et al. (2007); (c) Own calculation for Italian foodstuffs

Figures on biotic resources, abiotic resources and erosion were summed for each foodstuff and country in order to obtain the TMR for each foodstuff and one sum for each country (Tab. 5). Relating the global TMR to the annual consumption of food per capita of the respective country we got the average intensities of resources that is the average amount of materials that is used for consuming one kilogram of food, in each country. In Table 5 the countries are sorted by the Average Material Intensity (AMI) values. These figures were used for deducing which factors are more affecting the natural resource consumption of nutrition, because they are not affected by the levels of consumption of the 18 foodstuffs considered.

Table 5. Total food consumption, TMR and AMI of food in 25 European countries.

	Country	Total food consumption (kg/capita/yr)	Total Material Requirement (kg/capita/yr)	Average Material Intensity of food (kg/kg)
II group: low-AMI countries	**Romania**	657,4	4421	**6,72**
	Poland	515,5	4140	**8,03**
	Bulgaria	492,4	3979	**8,08**
	Lithuania	467,8	3954	**8,45**
	Ireland	650,9	5504	**8,46**
	Neatherland	616,0	5432	8,82
	Hungary	497,7	4426	8,89
	Slovakia	419,5	3733	8,90
	Latvia	393,1	3528	8,97
	Greece	737,0	6669	9,05
	Finaland	581,8	5357	9,21
	Estonia	502,1	4683	9,33
	Malta	625,3	5873	9,39
	Spain	636,7	6103	9,59
	Denmark	609,0	5858	9,62
	Portugal	610,5	5959	9,76
	Sweden	564,0	5565	9,87
	Slovenia	485,3	4790	9,87
	United Kingdom	528,1	5213	9,87
	Czech Republik	460,5	4648	10,09
I group: high AMI countries	**France**	627,8	6413	**10,22**
	Italy	614,2	6531	**10,63**
	Belgium	549,9	6034	**10,97**
	Austria	472,4	5218	**11,05**
	Germany	453,9	5069	**11,17**

Germany, Austria, Belgium, Italy and France have the highest scores of AMI (group 1), while Romania, Poland, Bulgaria, Lithuania and Ireland (group 2) have the lowest one. This means that one unit of generic food consumed in one of the first group countries is more resource consuming then one unit from the second one. This depends on diet habits, since we excluded the environmental conditions and agricultural practices from the analysis. Looking at the contribution of different foodstuff groups to the TMR of diets of these countries the following factors can be identified as responsible for high natural resource consumption:

1. high consumption of animal origin food (sum of cattle, pork, poultry, milk, sheep and goats, fish and seafood, butter, cheese and eggs);
2. high consumption of beef (cattle)
3. high consumption of red meat (cattle and pork)
4. low consumption of the group "cereals and potatoes" (sum of wheat, rice and potatoes)

As in carbon emission evaluations (Kramer et al., 1999) the animal productions, and especially beef, are proved to account in a relevant way for a high impact diet. Tab. 6 shows the values of these factors for the first group countries (with the highest average intensity) and for the second one (with the lowest). The averages of the groups are consistent with the factors we identified for being responsible for a more intensive diet in terms of natural resource consumption. Looking at the single countries there are some exceptions, like the first parameter for Italy (animal products) is widely below the group average and the cereals and potatoes consumption is more similar to the second group for this country. Poland and Ireland have also relatively high values for meat consumption. German consumption of cattle, instead, is quite low but compensated by pork.

Table 6. Factors affecting the natural resource consumption due to nutrition.

		Natural resource consumption for nutrition (Kg)	Average Material Intensity (Kg of materials/1 Kg of food)	Contribution of the sub-components to the TMR (%)			
				Animal origin food	Red meat	Cattle	Cereals and Potatoes
I group	Germany	5069	11.2	61.6	29.0	12.0	9.8
	Belgium	6034	11.0	57.3	31.4	17.7	10.3
	Austria	5218	11.0	64.3	34.3	16.8	8.8
	Italy	6531	10.6	50.1	28.0	18.5	14.8
	France	6413	10.2	63.7	28.8	20.2	10.7
II group	Romania	4421	6.7	51.3	18.8	8.7	19.3
	Bulgaria	3979	8.1	51.6	26.2	12.0	19.8
	Poland	4140	8.0	59.4	26.2	7.7	15.0
	Ireland	5504	8.5	62.3	26.7	15.6	13.7
	Lithuania	3954	8.4	50.8	22.8	12.2	13.0
Average of 1st group			10.6	59.4	30.3	17.0	10.9
Average of 2nd group			7.9	55.1	24.1	11.2	16.2
Average increase from 2nd to 1st group (%)			+34.2	+7.8	+25.7	+51.8	-32.7

Conclusions

In sustainability assessment a material input based approach allows considering the natural resource consumption of products, services and economies with a broad perspective, indicating the generic pressure on environment due to human activities. In this paper we showed how MIPS provides reliable information on the potential environmental impact linked to nutrition, both on the production and consumption side. In the first part we applied MIPS to three foodstuffs and calculated the material intensity along the value chain. The results, pointing out how the impact is spread within the different life cycle phases, give guidelines for improving the sustainability in the system under investigation. In the case of pasta and concentrated juice, we observed a major contribution of the industrial processing in the whole material intensity. Fuels and electricity consumption are responsible for a big part of abiotic resources, water and air consumption. The substitution of the power provision with renewable sources can be looked upon for improving sustainability of these business lines. Farming is instead much more relevant for rice and natural orange juice's sustainability. The fertilizers administration and the water management are critical points especially for rice. The impact of pesticides is less visible, by reason of the small doses that are employed with new active ingredients, while MIPS accounts the mass units of material flows.

Our outcomes put on evidence the trade-off existing between biotic (renewable) and abiotic (no renewable) resources. The TMR of organic rice is indeed almost similar to the conventional one, because the abiotic resources (basically agrochemicals and plastic bags) are replaced with biotic materials (mustard seeds and cotton). Moreover, the lower yield of organic rice involves a larger use of soil for gaining the same unit of final product.

The European diets survey provides a rough quantification of the natural resource consumption due to the intake of 18 foodstuffs in 25 countries. The calculus of average material intensities for food unit allowed a comparison between different diets regardless of the amounts of food consumed. Countries with high material intensity have major share of beef and red meat intake, while cereals and potatoes consumption is bigger in countries with low material intensity. This confirms the higher environmental burden of meat and animal based products, consistently with other kinds of "nutrition ecology" analysis (carbon dioxide emissions, LCA, etc.).

Through these applications we showed that MIPS can be used for different purposes and at different levels of detail. The comprehensiveness of the indicator allows encompassing many aspects of the environmental burden and to get a rough quantification of the "use of nature" due to human activities. With modest efforts in terms of time and costs we obtained useful and easy to communicate information for guiding decision making of all the value chain stakeholders, from farmers to consumers, toward sustainability.

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