The German capability index – an operationalization of Sen's capability approach

Authors: Holger Schlör* (Orcid: 0000-0001-9098-3263), Wiltrud Fischer# (Orcid: 0000-0003-2927-6185), Sandra Venghaus* (Orcid: 0000-0002-9352-6604).

Institution: *Forschungszentrum Jülich, 52425 Jülich, Germany, Institute of Energy and Climate Research, Systems Analysis, IEK-STE. #University of Bonn, Department for Political Sciences and Sociology, Lennéstraße 25-27, 53113 Bonn.

Email: h.schloer@fz-juelich.de, s5wifisc@uni-bonn.de, s.venghaus@fz-juelich.de

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Abstract

When reflecting on the global call for sustainable development (Gutteres 2019), a question posed by Amartya Sen actuates further thought – namely that for who has to be sustained (Anand and Sen 2000a)? This question was answered by himself, proposing "it is not so much that humanity is trying to sustain the natural world but rather that humanity is trying to sustain itself (Sen 2013)." Against this background, in our research we addressed this question of who has to be sustained using Sen's capability approach for the case study of Germany. For this purpose, the German household survey (Einkommens- und Verbrauchsstichprobe (EVS)) of the German Federal Statistical Office is used to analyse five social household groups (all households, single households, single parents, couples without children, couples with children) according to their income (nine income classes) (Federal Statistical Office Germany 2020a; Federal Statistical Office Germany 2020b). Based on this survey, the question of who needs to be sustained will be analysed as follows:

1. First, the 'worldwide reach (Rosa 2019)' of the consumption patterns of the German household groups will be measured by their ecological and water footprints.
2. Second, an operationalization is derived for Amartya Sen's sustainable development definition using the Food-Energy-Water-nexus as the core of sustainable development (United Nations (UN Water) 2020), and to reveal both
    a. potential contradictions between the FEW sectors and other sectors of the German society which can negatively affect sustainable development in Germany, and
    b. the degree of inequality in functionings and capabilities among German households.
3. Finally, those household groups will be identified which 'have to be sustained' the most according to Sen's definition.

In the presented model, based on ul Haq (Fukuda-Parr 2003; Haq 1992; Haq 1995) and Sen (Anand and Sen 1994; Sen 2003), the German Capability-Index (GCI) is used to reveal both the capabilities and functionings of German society and the underlying justice structure of the German society. The capabilities (realization opportunities) in this context describe people's opportunities of using their functionings (abilities) to achieve a place in society (Venkatapuram 2011) given their personal capabilities, while simultaneously maintaining a sustainable use of the food-energy-water resources. The aim of the German Capability-Index (GCI) is to make the capabilities of the various German households comparable and establish the GCI as an index of revealed capabilities.

I Introduction

Secretary-General of the United Nations Antonio Gutteres expressed his concerns about the state of the world (Gutteres 2019) in Davos 2019, however, a question posed by Amartya Sen actuates further thought – namely that for who has to be sustained (Anand and Sen 2000a)? This question was answered by himself, proposing "it is not so much that humanity is trying to sustain the natural world but rather that humanity is trying to sustain itself (Sen 2013)," because “the precariousness of nature is our peril, our fragility (Sen 2013).”

This, however, would inevitably imply accounting for inter- and intragenerational justice and thus require the setting of ecological restrictions on the use and the management of the Food-Energy-Water-nexus (FEW-nexus) resources in order to reduce (as will be discussed in further detail below) the current as well as future ‘worldwide reach’ (Rosa 2017) of consumption and production patterns.

Hence, for humanity to sustain itself, especially the core of sustainable development – namely the Food-Energy-Water-nexus (United Nations (UN Water) 2020) – must first and foremost be transformed to become sustainable. This core is currently affected by global challenges as described in the IPCC Reports (IPCC 2018; IPCC 2019a; IPCC 2019b) and reflected in the UN Sustainable Development Goals (United Nations 2015).

With respect to human development, these challenges endanger the vision of the UN with respect to “the rule of law, justice, equality and … of equal opportunity permitting the full realization of human potential and contributing to shared prosperity (United Nations 2015)” and thus the chances of a decent life around the globe.

Based on the ideas of Immanuel Kant (Kant 1785), development means providing people with an environment which enables them to live a long, healthy and creative life (Anand and Sen 1994), which enlarge people’s choices and opportunities (Anand and Sen 1994; United Nations Development Programme (UNDP) 1990). Hence an essential differentiation must be made between the means which can be used for a certain development and the ultimate aim of this development: the welfare of the people (Sen 2013; United Nations Development Programme (UNDP) 1990).

Against this background, sustainable development can be defined in line with Sen’s capability approach as a "development that prompts the capabilities of present people without compromising capabilities of future generations (Sen 2013).” Intragenerational social justice corresponds to “equality of capabilities (Merkel 2007a)”, which are not restricted by the consumption patterns of others.

So far, Sen’s idea of capabilities has been applied among others in the context of energy justice and sustainable development by various scientists: Altman 2012 uses Sen’s capabilities approach in order to analyse socioeconomic development and the well-being of individuals. It is of interest for Altman to highlight the correlation of individual capabilities and the imagination of a decent life with the concept of economic welfare (Altman 2012). Bartiaux present a theoretical and empirical framework for a nexus among energy justice and capabilities (Bartiaux et al. 2018). This statistical operationalization of Sen’s and Nussbaum’s concept of capabilities examines all households of Belgium; nevertheless, it is

transferable to other countries as well. Also Biggs et al. 2015 present an integrated assessment approach for the nexus of water, energy, food and a sustainable decent life (Biggs et al. 2015). Bartiaux et al. 2016 examine energy policy-related inequalities of different social classes in Belgium and Portugal against the background of various justice theories (Bartiaux et al. 2016). Hillerbrand 2018 enlarges the scope of the capability approach by including reflections on sustainability and its criticisms (Hillerbrand 2018). This way the synergies between the environment and individuals' well-being are included. Sovacool und Dworkin 2015 propose concepts of energy justice as a base for a conceptual and decision-making tool to better integrate procedural and distributive justice concerns (Sovacool and Dworkin 2015). Martínez-Guido et al. 2019 introduce a newly developed optimization approach including the water–energy–food nexus in order to improve the Human Development Index (Martínez-Guido et al. 2019). Thereby they take into account environmental and social sustainability criteria.

Nevertheless, it can overall be stated that the specific combination of Sen's capability approach with the concept of the FEW-nexus is not yet explicitly found in the corresponding research disciplines. The present study thus represents a first attempt to operationalize these two concepts in order to close this research gap.

Thus, in the following the capability approach will be presented. Its objective is to leave the traditional welfare economics behind, which interpret the standard of living only in terms of consumed goods (Sen 2003). In the first step, the conceptual background of Sen's capability approach will be discussed and its content-related connection to the concept of worldwide reach of Hartmut Rosa will be elucidated. In the second part, the two-step approach is presented to define the current status of the German FEW-Nexus sectors and the impact of the German households on food, energy, and water resources. In a third step, the German capability index (GCI) is presented, which enables the comparison of direct and indirect effects of the German households' consumption patterns in one index. Finally, some concluding remarks and an outlook of further research recommendations will be made.

II Conceptual Background – the Capability Approach

II.1 Capabilities, functionings and their worldwide reach

Capabilities (realization opportunities) describe a person's opportunities of using her or his functionings (abilities) to reach her or his place in society given the respective personal skills (Sen 2003). They describe the possible paths of life available to a person given her or his abilities. As such, capabilities are thus enablers of the 'worldwide reach expansion' of the modern times, defined by Hartmut Rosa as the categorical imperative of the modern age (Rosa 2019): Act at any time so that your world in reach becomes larger (Rosa 2017). This is done by the multiplication of goods, contacts and options which increase with growing functionings. This new idea of modernity brings 'more world within reach', to make more world understandable and consumable. Accordingly, the consumption decisions of the households affect societies and communities around the world (Rosa 2018).

Hartmut Rosa believes that the modern age is characterized by the central endeavour of making the world more accessible in all social spheres and areas of life (Rosa 2019) . In this sense, the human quest

is a systematically increase of the range of what is recognizable, controllable, attainable and available (in education, medicine, media, politics, sports, etc.) based on the earned income (Rosa 2018). The worldwide reach increases with rising income. The available income and technology enable an increase in reach of the households and are a symbol of the freedom of choice.

The higher the income the higher the worldwide reach of the consumption patterns and the impact on the functionings and capabilities of people outside the own community and society. Thus, we revert to the capability approach to define measures for quantifying the worldwide reach of the German households.

II.2 The capabilities – a vector of abilities

Capabilities can therefore be described as a vector of an individual's abilities, which are, in turn, a function of basic social conditions (democracy, freedom) (Deneulin and Shahani 2009; Sen 2007) and their worldwide reach: $\overrightarrow{\left(v_{capabilites}^{individual}\left(\text{functionings, worldwide reach}\right)\right)}$.

Similar to a person who has a lot of money and can purchase many goods, a person with many capabilities can choose between different life concepts (Deneulin and Shahani 2009), as the following example explains (Deneulin and Shahani 2009; Robeyns 2005): A wealthy person who is fasting may have the same functional performance as a poor person with respect to nutrition. However, whereas the poor person may have to starve, the wealthy person has the capability to choose whether to eat or fast. Hence, the wealthy person has a greater worldwide reach than the poor person, who has no choice (Robeyns 2011; Sen 2003). In the same way, a person who is only equipped with the most basic functionings, e.g.

$\overrightarrow{\left(v_{capabilities}^{\text{poor person}}\left(\text{functionings (food, clothes, basic education, low worldwide reach)}\right)\right)}$ has very little opportunity of becoming, e.g. an architect or a surgeon. Her or his capabilities are limited because of the personal functionings (Robeyns 2011). The individual capability budget is small, whereas the capability budget of, e.g. the architect is significantly higher expressed in a sophisticated capability vector:

$$\overrightarrow{\left(v_{capabilities}^{architect}\left(\text{functionings (food, clothes, higher education, high worldwide reach)}\right)\right)}$$

The capability budget describes the different possible combinations of functionings (abilities) a person can achieve (Leßmann 2014). The budget contains the means which allow a person to live a certain life (Kuklys 2005), or the paths of life which remain closed to him because of his limited capability budget (Lessmann 2009). The capability budget of a person therefore describes the possibilities of a person to live the life she or he wishes (Nussbaum and Sen 1993; Sen 1985a).

These functionings enable people to achieve an income and enable consumption decisions to purchase the goods that go along with a certain worldwide reach. The functionings therefore refer to the possibility of fulfilling individual needs. Moreover, a distinction is made between people's basic needs (food, clothes, and basic education) and further abilities such as playing an instrument or speaking a foreign language.

Sen uses his capability approach to specify his justice approach, defining social justice as “equality of capabilities (Merkel 2007b)” and assume basic rights to be essential for a good life (Sen 2009). The opportunities of people are expressed in their capability budget (Nussbaum and Sen 1993), which defines people’s welfare and “the person’s freedom to lead one type of life or another (Sen 2007)”, based on institutional conditions. Amartya Sen and Martha Nussbaum try to capture people’s well-being in their capability approach by considering not only people’s income but also non-monetary aspects (values, capabilities) which influence people’s welfare and their quality of life (Nussbaum and Sen 1993). Hence, the composition of the capability budget is a question of institutional justice (Sen 1979; Sen 1985b; Sen 2003), because as Jean-Baptiste Henri Lacordaire stated: “Entre le fort et le faible, entre le riche et le pauvre, entre le maître et le serviteur, c’est la liberté qui opprime et la loi qui affranchit[1] (Leuprecht 2005)." Sen’s welfare approach defines welfare from two sides (Kuklys 2005): The outcome people can achieve based on their functionings or based on the opportunities they have according to their capability budget. Hence, welfare is a function of outcome and opportunities.

In a next step, based on the model of Sen and the methods set up by Mahbub ul Haq in the conceptual framework of the human development report and its Human Development Index (HDI), we derive a method to reveal and to measure the capabilities and functionings of the German society including the worldwide reach. We use our revealed functioning approach to capture the following functionings based on the Human Development Index: welfare, nourishment, decent and healthy life, mobility, social cohesion and education to define social justice as equality of capabilities.

III Measuring the worldwide reach of German households on the FEW-nexus

The proposed two-step approach first measures the current state of the FEW-nexus sectors and the impact of the German households on food, energy and water. The approach follows the objective to consider both the direct effects of the consumption of food, energy and water measured by German household survey data, but also the indirect effects caused by the German consumption patterns measured by the ecological footprint and the water footprint. Both measures belong to the environmental footprint indices (Neumayer 1999; Neumayer 2003).

Secondly, it reveals the functionings and capabilities of the German households through the German Capability Index (GCI).

III.1 German Household Survey (EVS)

For our analysis we use the latest German household survey data “Einkommens- und Verbrauchsstichprobe 2018” (EVS) of the German Statistical Office (Federal Statistical Office Germany 2020a; Federal Statistical Office Germany 2020b) to make functionings observable, measurable, and

[1] Between the strong and the weak, between the rich and the poor, between the lord and the slave, it is freedom which oppresses and the law which sets free.

comparable. The household survey EVS records the income and expenditures of all German households (Federal Statistical Office (Statistisches Bundesamt) 2013). The EVS 2018 is the latest survey of the Federal Statistical Office of Germany and delivers important data for the assessment of the income situation, the standard of living and the expenditure behaviour of the whole population and the different households (German Federal Statistical Office 2005). The EVS database therefore provides information about German economic life and consumer behaviour (Federal Statistical Office (Statistisches Bundesamt) 2013). The EVS methodology is based on the Eurostat recommendations for "Household Budget Surveys in the EU (European Commission 2003)."

The EVS database characterizes a household (Federal Statistical Office (Statistisches Bundesamt) 2013) as an individual with own income who economizes for her-/himself as well as a group of related or personally linked people who belong together according to their income as well as according to their consumption. The latter must live together and dispose together of one or several incomes or income shares as well as supply a joint household (Federal Statistical Office (Statistisches Bundesamt) 2013). Households are analysed according to their social characteristics and their net income (Federal Statistical Office (Statistisches Bundesamt) 2013). The net income of the households is calculated by subtracting income tax, church tax, solidarity tax, and social insurance from the gross income (Federal Statistical Office (Statistisches Bundesamt) 2013). The disposable income of the chosen social groups is identified by adding to the net income the earnings from good sales as well as other income modes. Not included in the disposable income are earnings from the liquidation and conversion of monetary and material property as well as from borrowing (Federal Statistical Office (Statistisches Bundesamt) 2013). The savings of the households cover the expenses for the development of financial and tangible assets and repayment of credits (Federal Statistical Office (Statistisches Bundesamt) 2013).

For this analysis, we use the data of 40.6 million households in Germany covering the following household groups: all households (40.6 million), single women (10.6 million), single men (6.5), single parents (1.2 million), couples without children (11.7 million), and couples with children (5.8 million) with further differentiation between the following income groups: under 900 €, 900-1300 €, 1300-1500 €, 1500-2000 €, 2000-2600 €, 2600-3600 €, 3600-5000 €, 5000-18000 € (Federal Statistical Office Germany 2020a; Federal Statistical Office Germany 2020b). The group of other households[2] (4.9 million) will not be analysed. We use the data on income and expenditures of these households to define their material functionings: earnings, savings, food, beverages, tobacco, clothing and shoes, living, household tools and furniture, health, transport, communications, entertainment, leisure time, education, restaurants and services (Federal Statistical Office (Statistisches Bundesamt) 2013). The data "living without energy" contains the hot, cold and waste water costs of the households, but it is not possible to further differentiate between these respective water costs. Hence, the following FEW-nexus expenditure costs are the minimum expenses of the households for the FEW-nexus goods.

[2] Other households are those household which have further household members (e.g. parents-in-law, children of full age) (Federal Statistical Office (Statistisches Bundesamt) 2013).

Table 1: All households

All households according to their net income, 2018

from .. to.. , in €	All households	under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	40683	2006	3413	1816	4803	5475	7250	6895	9024
Food, beverages	360	170	193	220	249	295	354	434	540
Clothing and shoes	122	29	42	55	68	87	109	148	229
Living without Energy+	762	336	409	459	526	618	755	902	1164
Energy living	146	63	78	93.5	118	167	270	306	372
Interior equipment, household issues	137	22	40	53	67	91	126	165	269
Health care	50	7	16	18	28	41	58	82	117
Mobility without fuel	308	21	53	59	102	123	186	306	554
Fuel	71	41	48	60	70	115	150	170	208
FEW-Nexus expenditures*	577	274	319	373.5	437	577	774	910	1120
Communication	71	37	43	50	54	61	70	83	99
Leisure and culture	304	65	99	131	166	218	285	372	557
Education	28	8	6	7	11	14	21	33	63
Accomodation and Catering	168	36	49	60	80	113	146	205	334
Other commodities and services	111	32	46	60	67	85	107	129	194
Total consumption	2704	901	1152	1352	1625	2016	2551	3252	4657
Expendable income	3726	747	1125	1427	1786	2331	3125	4327	7739
FEW-Nexus expenditures in % of total consumption	21.3	30.4	27.7	27.6	26.9	28.6	30.3	28.0	24.0

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

Table 1 shows that FEW-nexus expenditures account for more than 20% of the expenditures of the average German household. In the lowest income group the households spend on average 30% of their consumption expenditures for the FEW-nexus resources. With growing income the nexus share decreases to 24% in the highest income group. The importance of the FEW-nexus expenditures for the households decreases with increasing income. The FEW-nexus commodities are relative inferior [3]goods.

Table 2: Single women

Single woman households according to their net income, 2018

from .. to.. , in €	All households	under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	10595	1041	2058	938	2353	1927	1495	522	260
Food, beverages	209	159	179	196	210	227	236	259	275
Clothing and shoes	78	35	46	58	74	93	114	138	190
Living without Energy+	560	328	405	453	532	623	766	892	1047
Energy living	108	80	92	100	107	115	127	144	158
Interior equipment, household issues	78	22	42	53	71	93	118	164	224
Health care	72	26	33	42	55	71	109	181	393
Mobility without fuel	128	41	59	79	112	150	211	312	329
Fuel	45	12	23	33	45	55	73	81	81
FEW-Nexus expenditures*	362	251	294	329	362	397	436	484	514
Communication	50	35	41	45	50	54	60	64	74
Leisure and culture	189	64	97	149	174	223	295	362	474
Education	8	7	5	5	7	8	10	12	29
Accomodation and Catering	84	36	41	59	74	103	130	170	216
Other commodities and services	84	38	49	69	76	92	120	144	301
Total consumption	1692	884	1112	1342	1585	1907	2370	2921	3791
Expendable income	2077	754	1117	1432	1771	2306	3068	4200	8420
FEW-Nexus expenditures in % of total consumption	21.4	28.4	26.4	24.5	22.8	20.8	18.4	16.6	13.6

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

Table 2 shows the expenditure structure of the single woman households. The single woman households spend on average 352 € for FEW-nexus products. In the lowest income group the households spend only 251 € per month for FEW-nexus commodities. This value increases with rising income to 514 € in the highest income group. On average 21.4 % of the household consumption expenditures are allocated to the FEW-nexus goods. This percentage share has its highest value with 28.4 % in the lowest income group, the share decreases to 13.6 % in the highest income group. The relativity of the inferior good characteristic of the FEW-nexus goods is increasing.

[3] A detailed explanation of inferior, normal, and superior goods can be found by (Krugman and Wells 2018; Wied-Nebbeling 2007)

The single man households (table 3) show a similar consumption structure as the single woman households. Single men spend on average 380 € - 22 % of total consumption - for FEW-nexus commodities. In the lowest income group (under 900 €) this spending decreases to only 270 € for FEW-nexus commodities, whereas this value increases with rising income and reaches its highest value with 510 € in the highest income group, while the economic significance decreases with rising income. The FEW-nexus share decreases from 32 % in the lowest income group to 15 % in the highest income group.

Table 3: Single men

Single man households according to their net income, 2018

from .. to.. , in €	All households	under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	6472	909	1023	460	1036	1047	1036	595	368
Food, beverages	217	175	193	204	222	229	234	242	261
Clothing and shoes	49	21	28	40	44	54	65	77	95
Living without Energy+	548	326	398	444	479	576	683	820	946
Energy living	102	82	87	92	101	106	112	130	125
Interior equipment, household issues	70	18	32	51	59	78	104	117	161
Health care	71	15	24	30	43	53	83	160	352
Mobility without fuel	184	35	92	98	133	200	293	369	411
Fuel	61	13	26	43	62	77	87	97	124
FEW-Nexus expenditures*	380	270	306	339	385	412	433	469	510
Communication	53	37	44	52	54	57	61	66	71
Leisure and culture	184	57	102	115	172	198	257	317	397
Education	8	7	7	6	7	9	9	9	11
Accomodation and Catering	123	34	63	71	91	139	166	240	305
Other commodities and services	79	32	53	81	81	101	120	148	171
Total consumption	1729	843	1127	1290	1512	1834	2237	2735	3406
Expendable income	2355	759	1116	1423	1796	2316	3115	4281	7337
FEW-Nexus expenditures in % of total consumption	22.0	32.0	27.2	26.3	25.5	22.5	19.4	17.1	15.0

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

The meaning of the FEW-nexus for the consumption decisions of the households decreases with rising income. The relativity of the inferior character is not so distinct as in the group of single women.

For the single parent's households a slightly different picture is revealed (table 4). The average single parent's household uses 24.2 % (535 €) of its consumption budget for FEW-nexus expenditures. In the lowest income group, the households spend 364 € for FEW-nexus goods, i.e. these households use on average 28.3 % of their consumption budget for FEW-nexus goods.

Table 4: Single parents

Single parents households according to their net income, 2018

from .. to.. , in €	All households	under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	1234	Null	76	114	294	291	261	135	24
Food, beverages	333	Null	232	257	305	339	352	422	321
Clothing and shoes	49	Null	28	40	44	54	65	77	95
Living without Energy+	639	Null	412	439	517	591	728	924	1158
Energy living	141	Null	90	103.5	132	233.5	282	282	350
Interior equipment, household issues	99	Null	36	47	55	99	112	195	378
Health care	60	Null	18	22	28	41	57	119	283
Mobility without fuel	165	Null	130	44	128	125	148	352	484
Fuel	61	Null	42	65.5	83	180.5	166	170	206
FEW-Nexus expenditures*	535	Null	364	426	520	753	800	874	877
Communication	71	Null	50	57	62	74	74	92	133
Leisure and culture	240	Null	93	100	150	237	309	395	373
Education	41	Null	0	0	28	38	47	91	91
Accomodation and Catering	109	Null	34	38	64	101	144	197	122
Other commodities and services	103	Null	56	56	71	98	133	153	268
Total consumption	2208	Null	1288	1326	1692	2100	2489	3408	4411
Expendable income	2601	Null	1217	1419	1795	2313	3063	4224	6670
FEW-Nexus expenditures in % of total consumption	24.2	Null	28.3	32.1	30.7	35.9	32.1	25.6	19.9

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

This share decreases also for the single parents to 19.9 % in the highest income group but the absolute expenses of the households increase with rising income from 364 € in the lowest income group (900-1300) to 877 €. The highest income group spends more than twice the amount of the lowest income group for FEW-nexus goods. The FEW-nexus goods change their character for this household group with rising income. For the households with a monthly net income between 2000 and 2600 € the FEW-nexus goods are relative superior commodities, the meaning of these goods increases with growing

income but for the households with higher income the meaning diminishes and changes into a relative inferior good.

In the following we will analyse, which picture is created by the analysis of the couple households.

The couples without children spend on average 693 € on FEW-nexus related goods (table 5). This accounts to only 21.7% of the consumption budget for these commodities, which is lower than in the case of the single parent households. The households of the lowest income group spend nearly 28 % of their consumption budget for FEW-nexus products, but, atypically in this social group, the saturation point of the highest share spent on these goods is reached in the second lowest income group and after this peak the share decreases slightly to 24 % in the highest income group. However, as in the previous social groups the absolute amounts spent for the FEW-nexus increase continuously up to the highest income group (1096 €).

Table 5: Couples without children

Couples without children households according to their net income, 2018

	All households	from .. to.. , in € under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	11722	Null	194	214	755	1475	2920	2953	3180
Food, beverages	415	Null	299	315	339	363	400	427	474
Clothing and shoes	134	Null	53	54	70	84	105	140	206
Living without Energy+	866	Null	Null	524	563	641	785	910	1122
Energy living	167	Null	97	112	111	151	264	300	354
Interior equipment, household issues	174	Null	68	65	73	101	136	172	281
Health care	173	Null	46	35	53	84	108	163	329
Mobility without fuel	331	Null	154	62	107	153	243	352	552
Fuel	111	Null	44	53	71	115	235	248	268
FEW-Nexus expenditures*	693	Null	440	480	521	629	899	975	1096
Communication	75	Null	51	53	57	62	69	79	91
Leisure and culture	380	Null	111	113	155	236	305	399	586
Education	11	Null	8	10	13	9	9	11	15
Accomodation and Catering	221	Null	54	56	86	121	158	230	370
Other commodities and services	131	Null	67	56	68	90	106	131	199
Total consumption	3189	Null	1583	1505	1781	2174	2686	3311	4560
Expendable income	4389	Null	1187	1418	1806	2358	3140	4318	7593
FEW-Nexus expenditures in % of total consumption	21.7	Null	27.8	31.9	29.3	28.9	33.5	29.4	24.0

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

For the couples without children, the FEW-nexus commodities are slightly relative inferior goods.

The couples with children present a different picture in contrast to the previous social groups. The average households spend 22.6 % of their consumption budget for the FEW-nexus goods. These households spend on average 867 € for these commodities. This spending reaches its saturation point in relative terms in the income group of 2600-3600 €, whereas the expenses in absolute terms grow continuously until the highest income group. This social group spends on average 1217 € for FEW-nexus related commodities.

Table 6: Couples with children

Couples with children households according to their net income, 2018

	All households	from .. to.. , in € under 900	900 - 1 300	1300 - 1500	1500 - 2000	2000 - 2600	2600 - 3600	3600 - 5000	5000 - 18000
Extrapolated households, in 1000	5790	Null	86	85	136	365	867	1561	2824
Food, beverages	536	Null	325	357	392	449	474	518	585
Clothing and shoes	202	Null	66	93	88	108	133	178	255
Living without Energy+	996	Null	Null	Null	528	610	721	913	1203
Energy living	178	Null	111	125	140	123	286	306	352
Interior equipment, household issues	212	Null	108	78	65	86	132	175	283
Health care	117	Null	18	15	30	42	51	79	174
Mobility without fuel	435	Null	224	145	82	226	267	323	596
Fuel	153	Null	41	50	109	109	246	264	280
FEW-Nexus expenditures*	867	Null	477	532	641	681	1006	1088	1217
Communication	95	Null	78	68	73	86	91	92	100
Leisure and culture	420	Null	105	119	109	184	242	365	555
Education	104	Null	Null	16	48	50	71	87	133
Accomodation and Catering	234	Null	44	31	74	88	131	178	325
Other commodities and services	151	Null	79	67	63	89	108	133	187
Total consumption	3832	Null	1702	1498	1779	2275	2714	3367	4759
Expendable income	5602	Null	1180	1426	1808	2388	3189	4391	7668
FEW-Nexus expenditures in % of total consumption	22.6	Null	28.0	35.5	36.0	29.9	37.1	32.3	25.6

Source: German Statistical Office, 2020, and own calculations, *) Food, beverages, energy living, fuel, +) contains the hot, cold and waste water costs IEK-STE 2020

For the couples with children the meaning of the FEW-nexus commodities also changes with rising income. Until an income of 1500-2000 € the goods have a relative superior character, and then the character changes to a relative inferior good, similar to the single parents.

In the following we will analyse the indirect effects of the consumption patterns of the German households on the FEW-nexus sectors not only in Germany but also on a global level. To do so, we analyse in the following the effect of the household consumption expenses and its impact on the ecological footprint and the water footprint.

III.2 Ecological Footprint

The central starting point for the development of the ecological footprint was the recognition that people are part of nature and they depend on it and its goods (energy, wood, materials and water) and use nature as a repository for their waste (Wackernagel and Rees 1996; Wackernagel et al. 2002b). Water and energy are two life-support services of nature without which life would not be possible (Australian Government Department of Health 2020; Siebert 1982). Hence, ecological sustainability inevitably requires living within the boundaries of nature (Ayres et al. 1998; Ayres et al. 2001). The ecological footprint serves as a measure for this (Neumayer 2003).

Mathis Wackernagel describes the ecological sustainability approach in the development of the ecological footprint as follows: "Not living within our ecological means will lead to the destruction of humanity's only home. Having insufficient natural resources, not living decently and equitably will cause conflict and degrade our social fabric. Thus, the ecological footprint as an ecological sustainability tool determines whether 'people's quality of life improves over time' (Wackernagel et al. 1997)." The improvement of the human quality of life should take place within the ecological possibilities of the ecosystem. Wackernagel's approach calculates the impact that humans have on the earth and its resources using the ecological footprint (EF) (Wackernagel et al. 1997).

Different organizations have also developed methods to calculate ecological footprints for the earth, countries, regions and communities (WWF 2002).[4] In the following, the procedure developed by Wackernagel and Rees in 1996 and continued by the Global Footprint Network is presented (Wackernagel and Rees 1996), as it also serves as the basis for the WWF Living planet report (WWF 2020). For the Global Footprint Network the ecological footprint accounting system is "a method for calculating society's use of nature's assets (Burns et al. 2006)," as the food, energy and water resources.

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[4] http://www.myfootprint.org/
http://www.ecologicalfootprint.org/
http://www.redefiningprogress.org/
http://www.agenda21berlin.de/fussabdruck/vorstellung.html
http://www.deutschebp.de/sectiongenericarticle.do?categoryId=9008474&contentId=7015566
http://www.ecobusinesslinks.com/ecological_footprint_calculator.htm
http://www.ew.govt.nz/enviroinfo/indicators/community/sustainability/ecofoot/report.htm
http://www.bestfootforward.com/foot.html

Mathis Wackernagel defines the ecological footprint as follows: “It compares humanity’s ecological footprint (the demand our consumption places on the biosphere) with biocapacity (the biosphere’s ability to meet this demand), providing a kind of bank statement for the planet (Burns et al. 2006).” The ecological footprint thus adds up the various resources consumed by a given population and expresses them in units of productive land needed to provide these resources and to absorb its waste. The ecological footprint defines sustainability as a measure for the use of nature by humans: “The ecological footprint is a measure of how much biologically productive land and water area an individual, a city, a country, a region, or humanity requires to produce the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management schemes. This land and water area can be anywhere in the world (WWF 2006a).” Hence, “the global ecological footprint is [a] consequence of the increasing human demand for food, fibre, energy, and water (WWF 2004)” and hence, a measure for the FEW-nexus.

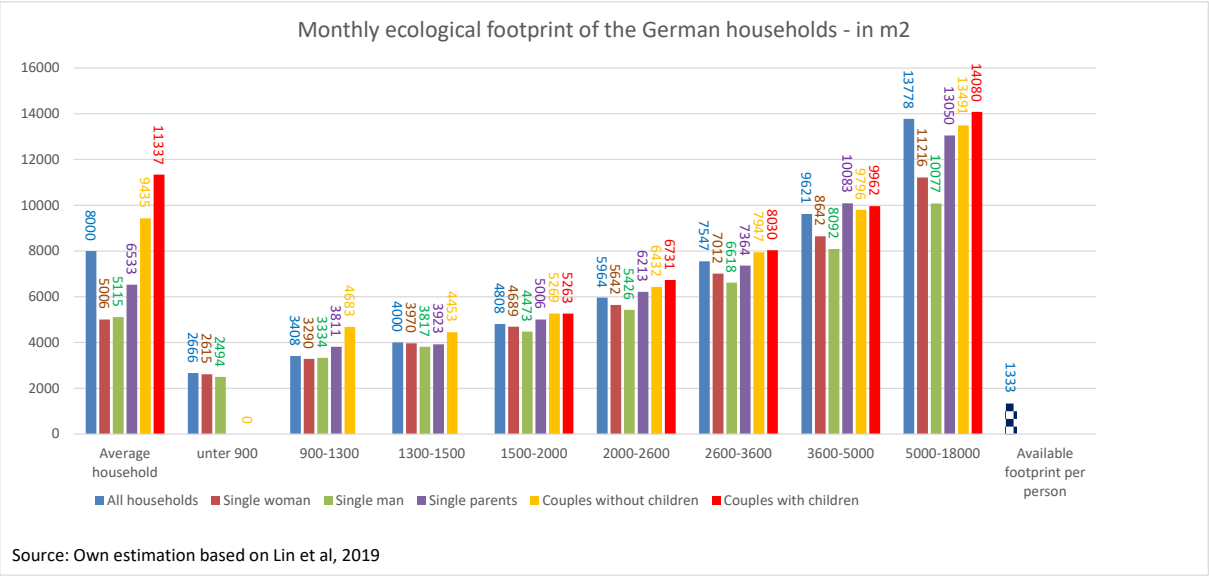
The biocapacity measures the ability of the earth to regenerate itself and the ecological footprint measures now the available biocapacity as well as the global demand for this capacity. “The common measurement unit is global hectares: biologically productive hectares with world average productivity. Thanks to this common measurement unit, countries, regions, cities, individuals and products can be compared across the world and over time (WWF 2020).”

The ecological footprint is based on seven sub-indices (Wackernagel et al. 2002a): Cropland Index, Grazing-Land Index, Fishing Index, Forest Index and the Indices for the capture of waste (CO2, nuclear) and the Build-up Index (Kitzes et al. 2008; WWF 2006b). The fossil fuel footprint is calculated on the basis of the area required to sequester the CO2 emissions from fossil fuels, minus the CO2 emissions absorbed by the oceans (WWF 2006b). Hence, the ecological footprint measures the global impact of the current production and consumption patterns on the food, energy, and water sectors worldwide. The ecological footprint put the focus on the current ecological realities on the stressed ecosystems (Burns et al. 2006).

The Global Footprint network calculated that in 2019 ca. 12.2 billion hectares of biologically productive land and water were available, so that every person has at his/her disposal 1.6 global hectares (Global Footprint Network 2019). This area also accommodates “the wild species that compete for the same biological material and spaces as humans (Global Footprint Network 2020).” The ecological footprint of a country or region summarizes the biological productive area on earth, which is needed to provide the resources for its consumption patterns under the current economic conditions (Global Footprint Network 2020).

III.3 Ecological Footprint Germany

Based on these considerations the Global Footprint Network detected for Germany that the German population causes an annual ecological footprint of 4.5 hectares (D. Lin et al. 2019; Global Footprint Network 2019). This implies that Germany is living beyond its means and needs nearly the resources of three Earths to provide the annually consumed resources. But the German households do not contribute equally to this footprint, as the following figure 1 shows (D. Lin et al. 2019).

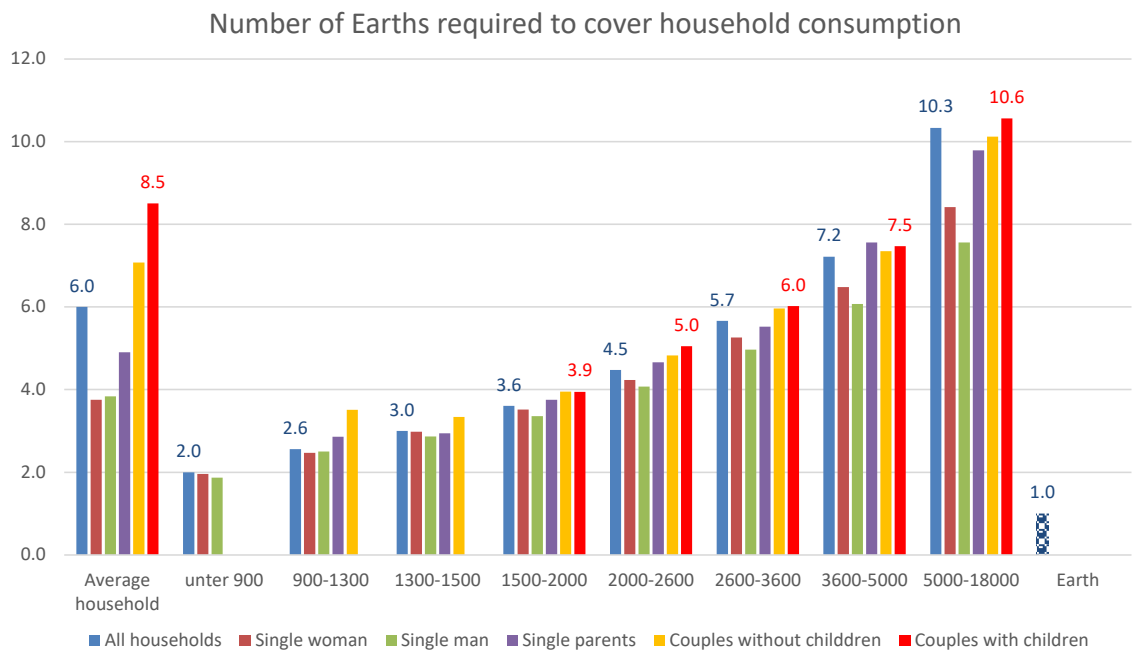


Source: Own estimation based on Lin et al, 2019

Figure 1: Ecological Footprint Germany

Figure 1 shows that the average ecological footprint of the average household is 8000 m^2 per month, so that the average footprint per person is 4,000 m^2, but only 1,333 m^2 of biocapacity per month are globally available. Figure 1 also shows that the footprint increases continuously with rising income and no social group is below the available biocapacity. The footprint increases for the group of all households from 2,666 m^2 for the households in the lowest income group to 13,778 m^2 in the highest income group. To measure the differences between the households, we measure the spread between the ecological footprint of the highest and lowest income group of the various social groups.

Hence, the footprint of the highest income is 5.2 times higher than in the lowest income group and 1.7 times higher than of the average household. For the single households the ecological footprint increases from 2,615 m^2 and 2,494 m^2 to 11,216 m^2 and 10,077 m^2 in the highest income group. The spread between the highest and the lowest income group is 4.0 and 4.3 for women and men respectively. For the single parents the ecological footprint increases also from 3,811 m^2 in the lowest income group to 13,050 m^2 which results in a spread of 3.4 between the lowest and highest income group. The couples without children cause on average an ecological footprint of 9,435 m^2, which increases from 4,683 m^2 in the lowest income group to 13,491m^2 in the highest income group. The couples with children produce on average an ecological footprint of 11,337 m^2, and the footprint reaches its highest peak at 14,080 m^2 in the highest income group. The spread between the lowest and highest income is smaller (2.9, 2.7), because for the lowest income group no data is available. In the following it will be analysed how many earths are needed to cover the consumption of the households differentiated according to their income, their social position and their size which varies between the social groups.



Source: Own estimation based on Lin et al, 2019,

Figure 2

Figure 2 shows that the average household needs six earths to cover its consumption needs, whereas the average couple household with children needs more than eight earths to cover its consumption needs. In the lowest income group the households (single men and women, and single parents) need two earths for their daily consumption. This value increases with rising income to more than ten earths in the highest income group for the couples with children.

These data reveal the worldwide reach and the impact of the German households on the global FEW-nexus through its consumption patterns. In the following, we will analyse which impact the German consumption patterns have on the global water system.

III.4 Water Footprint – the centre of the FEW-nexus

According to the Food and Agriculture Organization of the United Nations (FAO), water is the most important basic resource on earth (FAO 2014). To account for the exceptional meaning of water, we choose the water footprint to measure the impact of the German consumption patterns on the global water budget.

The water footprint is used to analyse the amount of water that used by German households not only directly through their personal water consumption, but also through the commodities they consume ((German Environmental Agency (Umweltbundesamt (UBA)) 2018): “Everything we use, wear, buy, sell and eat takes water to make (Water footprint network 2020).”

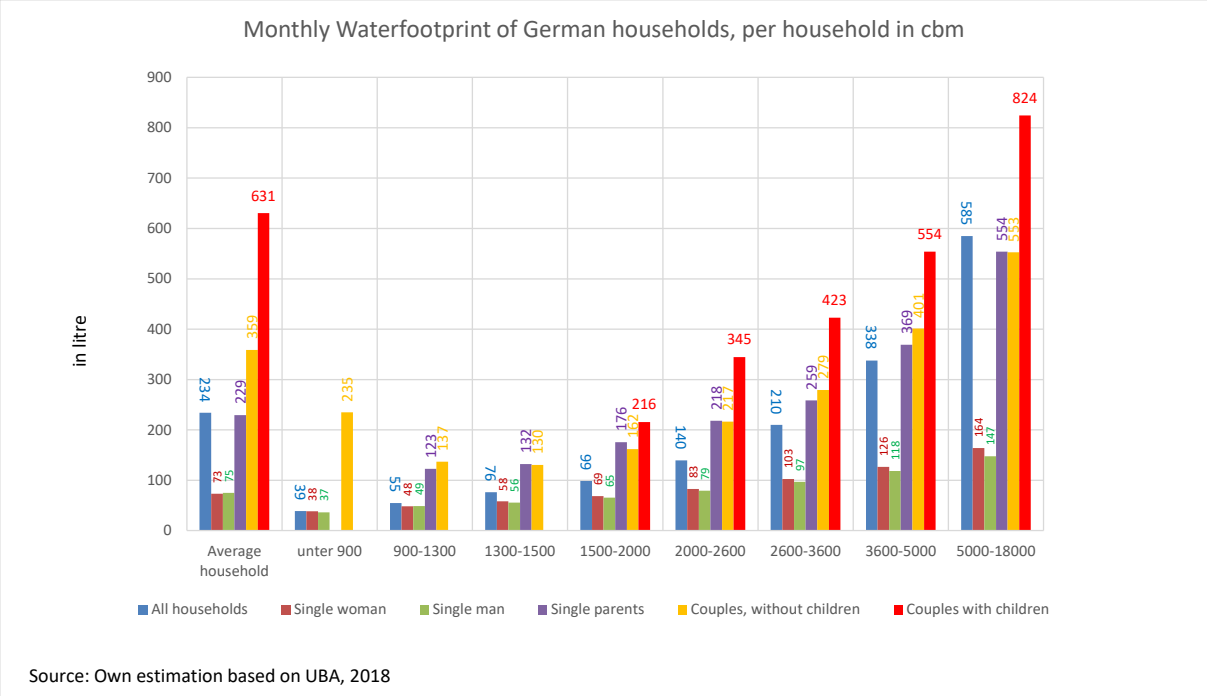
Hence, the water footprint measures the water consumption along the value chain of the production of industrial and agricultural goods as well as of the consumption of the various commodities. The water footprint is an indicator for the use of the resource water. The indicator makes the hidden water trade at the expense of water-poor countries more transparent ((German Environmental Agency (Umweltbundesamt (UBA)) 2018).

For Germany it is the German Environmental Agency (UBA) that calculates the water footprint. Germany’s total water footprint is 117 billion cubic meters (cbm) of water per year ((German Environmental Agency (Umweltbundesamt (UBA)) 2018), which corresponds to a daily consumption of nearly 4,000 litres per inhabitant. Furthermore, more than half of the water for the products and goods we consume does not originate from Germany. It represents instead the external water footprint of Germany through imported goods. The UBA detected that most of the water used in Germany is attributed to agricultural goods from Brazil, the Ivory Coast and France ((German Environmental Agency (Umweltbundesamt (UBA)) 2018).

In the following chapter, it will thus be analysed how much the various social groups according to their social status and income contribute to the German water footprint.

III.4.1 The Water footprint of the German households

The following figure shows the monthly water footprint of German households depending on their social position and their household income.



Source: Own estimation based on UBA, 2018

Figure 3: Water footprint of German households

Figure 3 shows the estimation of the various levels of water consumption according to German household groups. The estimation is based on the calculations of the UBA ((German Environmental Agency (Umweltbundesamt (UBA)) 2018). The average German household consumes 234 cbm of water per month, whereas single woman and single man households consume only 73 and 75 cbm a month respectively. Single parent households, in contrast, consume on average 229 cbm, households of couples without children 359 cbm, and couples with children 631 cbm of direct and indirect water. Figure 3 also shows that the water footprint increases continuously with rising income. In the group of all households, the households of the highest income group use on average 2.5 times more water than the average household of that social group. This spread is also valid for the group of single parents (2.4). In the case of single women and single men, these households use 2.0 and 2.2 times more direct and indirect water than the average household of this social group. This spread decreases for the couple households without children and for the couple households with children to 1.5 and 1.3 respectively. We thus conclude that the couple households share similar needs which are more independent of the income than is the case for other households. Analysing the relationship between direct and indirect water consumption between the highest and the lowest income group (the lowest income group with data available), we receive a different picture. The spread between the highest and the lowest income group in the consumption of direct and indirect water is 15 for the social group of all households. The highest income group consumes 15 times more water than the households in the lowest income group. This spread decreases to values around 4 for the single households and decreases further for the couple households to 3.8 and 2.4. Reverting to the idea of the worldwide reach

as discussed above, the worldwide water reach of German household's increases significantly with growing income.

So far, we have developed the data basis to estimate the capability index of the FEW-nexus in Germany, considering both direct and indirect effects of the German consumption and production patterns.

IV German capability index (GCI) – a measure of the worldwide reach

The GCI aggregates the water footprint, the ecological footprint and the data of the German household survey data into one index. The Capability Index enables the comparison of direct and indirect impacts of the German consumption patterns of German households on the FEW-nexus.

IV.1 Methodological Background

The methodological background of the presented approach is the Human Development Index (HDI) of the United Nations Development Programme (UNDP). The HDI of the UNDP is published regularly in the Human Development report (HDR) (United Nations Development Programme (UNDP) 1990). The concept of the HDI is based methodologically on Sen's capability approach (UNDP 2007; United Nations Development Programme (UNDP) 1990).

The UNDP selected three essential conditions (i.e. functionings, namely health, education and access to natural resources (energy, water etc.)) for human development, which have a decisive influence on people's capabilities:

- "to lead a long and healthy life,
- to acquire knowledge, and
- to have access to natural resources needed for a decent standard of living (Nussbaum 2007)."

These UNDP functionings must be part of the capability budget and thus define the life people can live. If these three conditions are not fulfilled, people's options are reduced or eliminated. In addition, according to UNDP, for human development further aspects are of central significance: political, economic and social freedom, the opportunity to have possessions, be productive and creative, and to have guaranteed human rights (United Nations Development Programme (UNDP) 1990). A decent life cannot be reduced to the earned income as the sum of human life (United Nations Development Programme (UNDP) 1990). UNDP argues in the tradition of Aristotle that "wealth is evidently not the good we are seeking; for it is merely useful and for the sake of something else (Aristotele 350 BC)." That "something else" is the opportunity "to realize the full potential of every human life, not just of a few, nor of most, but of all lives in every corner of the world—now and in the future (Clark 2017)."

Therefore we can summarize that UNDP and Sen do not focus their analysis on the goods people produce and consume, but Aristotle's "something else", which enables them to realize their potentials to live the life they want (Anand and van Hees 2006; Anand and Sen 1994; Anand and Sen 2000a; Anand

and Sen 2000b; Nussbaum and Sen 1993; Sen 1985a). The life they are capable of living is determined by their own set of functionings and values. In this welfare concept, “the lives the [household] lead … is of intrinsic importance, not the commodities or income that they happen to possess. lncome, commodities ("basic" or otherwise), and wealth do of course have instrumental importance but they do not constitute a direct measure of the living standard itself (Anand and Sen 1994).” The living standard is defined by the choices people have to live the life they want and to enlarge thereby their worldwide reach.

We allocated the income, the expenditure and their FEW-nexus connectivity of the German households to the functionings derived from the UNDP, as table 7 shows.

Table 7: Functionings, expenditures, Ecological and Water Footprint and the FEW-nexus

Functionings and Expenditures of German Households

Functionings	Expenditures	FEW Nexus
Welfare basis	earnings, savings	
Decent life	clothing, living, furniture	
Nutrition	food, beverages, tobacco	X
Health	health costs	
Mobility	transport costs	X
Social participation	Communications, leisure, services, restaurants and hotels	
Education	Culture and education	
Ecological Footprint	Nutrition, Mobility	X
Water Footprint	Water	X

Source: Authors 2019 based on UNDP, 2007 GDI.xlsx

The welfare basis in our approach is defined by the earnings and savings of the household, a decent life is defined by expenditures for clothing, living and furniture. Nutrition is covered by food, beverages and tobacco expenditures, whereas mobility is covered by transport costs and education by expenditures for culture and education. Social participation is described by expenditure for communications, leisure, services, restaurants and hotels. The FEW-nexus activities of German households are embedded in the direct functionings nutrition and mobility and the indirect functionings of the ecological and water footprint summarizing the worldwide reach of the households. The capability budget of German households contains direct and indirect functionings, which are used to describe the indirect and direct effects of the social life in Germany beyond the classic economic welfare analysis. In the following, the distribution of the capability budget is analysed against the background of Sen’s justice theory.

IV.2 German Capability Index (GCI) of the average household

Like the HDI, the Capability Index is a composite indicator which covers the following dimensions of human welfare of households: welfare basis, decent life, nutrition, mobility, social participation, education, and health. The aim is to make the capabilities of the various German households comparable and establish the CI as an index of revealed capabilities.

Based on the data and functionings of chapter III, the Capability Index is defined as follows:

First we normalize each direct expenditure and the indirect footprints of the households between 0 and 1 on the basis of the following equation (Anand and Sen 1994; United Nations Development Programme (UNDP) 2007). We set the households in relation to each other:

$$\text{Dimension index} = \frac{\text{actual value - minimum value}}{\text{maximum value - minimum value}}$$

We define the maximum and minimum expenditure levels over all income groups of all households for every specific expenditure group:

$$X_{Min} = Min\left\{x(i,j,k) \mid i \text{ in I, j in J, k in K}\right\}$$
$$X_{Max} = Max\left\{x(i,j,k) \mid i \text{ in I, j in J, k in K}\right\},$$

i (functionings) = i=1..I=9, j (income class) = j = 1..J=9), k (household type) = k=1..K=6.

In the second step, we calculate A^1:

$$A^1_{i,j,k} = \frac{\ln\left(x_{i,j,k}\right) - \ln\left(X_{Min}\right)}{\ln\left(X_{Max}\right) - \ln\left(X_{Min}\right)},$$

We use the logarithm of the expenditures, because achieving a respectable welfare level of human development does not require unlimited income and expenditures (United Nations Development Programme (UNDP) 1990), as is shown by the Easterlin paradox (Easterlin 1974; Shin 1980). The paradox summarizes the fact that an increase in income is positively correlated with an increase of individual benefits only up to a specific level of income; thus, above a certain threshold an improvement of the income situation is no longer connected to a similar increase of the benefit level.

Hence, we receive the Capability Index ($GCI_{i,k}$) of the specific income class (j=1...9) of the analysed household type of the social group (k=1...6) adjusted by the specific household size (H_k) of the social group.

$$CI_{i,\mathrm{j},k} = \frac{A^1_{i,j,k}}{H_k}$$

And the aggregate GCI – the capability budget of the households – is defined as:

$$GCI^k = \sum_{j=1}^{9}\sum_{i=1}^{9} CI_{i,j,k}$$

The higher the GCI is, the more capabilities the households can achieve. The GCI is defined between 0 and 1. The societal goal is a high GCI. In the case of the indirect capabilities of the ecological and water footprints the social goal is, as before, to minimize the footprint of the households. To convey this goal also to the ecological and water footprints, the equation has to be adjusted.

For the indirect capability index covering the ecological and water footprint of the FEW-nexus A^2 is defined without logarithm because the damage increases continuously without decreasing marginal ecological damage:

$$A^2_{i,j,k} = \frac{\left(x_{i,j,k}\right) - \left(X_{Min}\right)}{\left(X_{Max}\right) - \left(X_{Min}\right)}$$

The GCI for the FEW-nexus is:

$$GCI^{FEW}_{i,j,k} = 1 - \left(\frac{A^2_{i,j,k}}{H_k} \right)$$

The lower the water footprint and the ecological footprint are, the better is the global ecological and water situation caused by the consumption patterns of the German households and the higher is the GCI^{FEW} index.

Based on these basic equations, we calculate the German CI for the different household groups and the various income groups. In the following, we present the first results of our analysis.

IV.3 Operationalization of Sen's justice approach - the justice spread

The functionings of the households are summarized in their capability budgets. This budget thus represents the means of a household to enable a certain life for its members, or – in other terms –the 'worldwide reach' of the household. The direct functionings, for example, enable the employed household members to achieve a certain income. This income then enables further functionings, e.g., the next generation through better education, or the current generation through social participation. Hence, the functionings enable both intra- as well as intergenerational social participation.

However, in the following also the indirect effects of the functionings of the German households are measured through the ecological and water footprint. The actual, practical realization of the functionings of the German households affect the functionings of for example those people who are put under pressure through increasing ecological and water footprints. The worldwide reach of the functionings has external spatial effects.

These effects have impacts that can be explained on the basis of Sen's justice approach. For Sen, justice primarily relates to how humans actually live (Heidenreich 2011) and "how institutions organize the living conditions (Fischer and Hake 2017)," or as Rawls set it: 'Natural distribution is neither just nor unjust, nor is it unjust that persons are born into society at some particular position. These are simply natural facts. What is just and unjust is the way that institutions deal with these facts (Rawls, 1971)." Hence, it is important how the institutions deal with injustice.

Accordingly, the proposed justice spread can be interpreted as an operationalization of Sen's justice theory (Fischer and Hake 2017; Sen 2009) measuring the effects of institutional behaviour on the distribution of the capability budget between the social groups of German society as well as their impact on other people and societies. In this sense the justice spread also measures the differences in the worldwide reach between the German households.

The justice spread is defined as the difference of the capability budget between the consumption patterns of the highest and the lowest income group. In the first step we analyse the capability budget of all households shown in table 8.

Table 8: Capability Budget of all German households - 2018

Capability Budget of the German households & the FEW-Nexus - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Monthly net income							
					All households							
Welfare foundation	4047	662	1119	1427	1786	2331	3198	4643	8972	8972	662	14
Nutrition	360	170	193	220	249	295	354	434	540	540	170	3
Decent life+	1167	450	569	661	779	963	1260	1521	2034	2034	450	5
Health	50	7	16	18	28	41	58	82	117	117	7	17
Mobility	379	62	101	119	172	238	336	476	762	762	62	12
Social participation	654	170	237	301	367	477	608	789	1184	1184	170	7
Education	28	8	6	7	11	14	21	33	63	63	6	11
External FEW-Nexus related effects												
Ecological footprint in m^2	8000	2666	3408	4000	4808	5964	7547	9621	13778	13778	2666	5.2
Water footprint in cbm	234	39	55	76	99	140	210	338	585	585	39	15.0

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, +) includes hot, cold and waste water costs IEK-STE 2020

Table 8 shows the expenditures of German households for the seven functionings chosen for this analysis. The average German household has 4047€ as its welfare foundation and, given this economic basis, spends on average 360€ for nutrition, 1167€ are necessary to finance a decent life, 50€ are spent for health related issues of the household members, 379€ for mobility, 654€ for the social participation of the members of the household, and 28€ for education. The direct FEW-nexus expenditures of German households are summarized in the functionings nutrition, decent life and mobility. The external FEW-nexus related effects of the consumption patterns of German households are summarized in the ecological and water footprints.

The justice spread between the maximum and the minimum expenditures of the analysed households shows that the welfare foundation of the average German households differs significantly. The households of the highest income group hold a 14 times higher welfare foundation (earnings, savings) than the average household in the lowest income group. The high spread is caused mainly by the fact that the savings of the lowest income group are negative.

Further analysis shows that the spread differs significantly between the functionings. The justice spreads for nutrition and decent life are relatively low (at 3 and 5 respectively). It increases to 7 and 11 for social participation and education, and reaches its highest values for health (17) and mobility (12). Hence, the direct FEW-nexus spread ranges from 3 for nutrition to 12 for mobility. Hence the basic needs are more evenly distributed than for example mobility. The spread of the external effects of the households' consumption patterns is inconsistent. The spread of the ecological footprint is relatively low at 5.2, but is significantly higher for the water footprint (15) - the highest income group uses 15 times more direct and indirect water than the lowest income group. Accordingly, the worldwide reach is in this case 15 times higher than that of the low income households in this social group.

The analysis of single woman German households reveals a slightly different picture as table 9 shows.

Table 9: Capability budget of single women - 2018

Capability Budget of the German households & FEW-Nexus - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Monthly net income							
					Single Woman							
Welfare foundation	2207	711	1117	1432	1771	2401	3314	4903	11477	11477	711	16
Nutrition	209	159	179	196	210	227	236	259	275	275	159	2
Decent life+	824	465	585	664	784	924	1125	1338	1619	1619	465	3
Health	72	26	33	42	55	71	109	181	393	393	26	15
Mobility	173	53	82	112	157	205	284	393	410	410	53	8
Social participation	407	173	228	322	374	472	605	740	1065	1065	173	6
Education	8	7	5	5	7	8	10	12	29	29	5	6
External FEW-Nexus related effects												
Ecological footprint in m^2	5006	2615	3290	3970	4689	5642	7012	8642	11216	11216	2615	4.3
Water footprint in cbm	73.26	38	48	58	69	83	103	126	164	164	38	4.3

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, +) includes hot, cold and waste water costs IEK-STE 2020

Table 9 shows that the justice spread of the welfare foundation is 16, i.e. the justice spread of the single woman households is higher than that of the average household. The distribution for nutrition

(2) and decent life (3), in contrast, is lower. The justice spread increases significantly to 15 for health expenditures of single women. Single women in the highest income group can spend on average 15 times more on their health care than the women in the lowest income group. The mobility spread (8) of single woman households is lower than that of the average household. The same holds true for social participation and education (both 6). The table further shows that the justice spread of the external FEW-nexus related effects (4.3) is nearly as low as the spread of nutrition and decent life. So overall it can be concluded that the worldwide reach of the household functionings in this social group is rather heterogeneous.

Table 10: Capability budget of single men - 2018

Capability Budget of the German households & FEW-Nexus - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	Monthly net income below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Single Man							
Welfare foundation	2672	655	1059	1449	1892	2507	3483	5082	10153	10153	655	16
Nutrition	217	175	193	204	222	229	234	242	261	261	175	1.5
Decent life+	769	447	545	627	683	814	964	1144	1327	1327	447	3
Health	71	15	24	30	43	53	83	160	352	352	15	23
Mobility	245	48	118	141	195	277	380	466	535	535	48	11
Social participation	439	160	262	319	398	495	604	771	944	944	160	6
Education	8	7	7	6	7	9	9	9	11	9	7	1.3
External FEW-Nexus related effects												
Ecological footprint in m2	5115	2494	3334	3817	4473	5426	6618	8092	10077	10077	2494	4.0
Water footprint in cbm	75	37	49	56	65	79	97	118	147	147	37	4.0

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, +) includes hot, cold and waste water costs IEK-STE 2020

The average welfare foundation spread of single men is higher (16) than that of the average household and equal to the single woman households (table 9), whereas the nutrition spread (1.5) of this group is the lowest of all functionings of all analysed households. The justice spread for the decent life is in the range of that of the single women. The spread of the health expenditures, in contrast, is higher (23) than that of single women, as well as in the case of mobility (11). For social participation (6), in contrast, the spread is the same as that of the single women group. Striking is in the case of the single man households that the spread of the education expenditures with 1.3 is the lowest across all households, as table 10 shows. The average single man of the highest income group spends only 4 € more for education than the average single man in the lowest income group. The FEW-nexus justice spread of the single man is a little bit lower for the nutrition functioning in comparison to the single woman. The decent life spread is the same, whereas the mobility spread is higher for single men. The external effects of the consumption patterns of the single man households are more independent from the earned income. The effects are just 4 times higher in the highest income group than in the lowest income group. The worldwide reach differs only marginally between the households with rising income.

In the following we will analyse the capability budget of single parent households.

Table 11: Capability budget of single parents - 2018

Capability Budget of the German households & FEW-Nexus - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	Monthly net income below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Single Parents							
Welfare foundation	2738	Null	1195	1419	1795	2313	3836	4678	8304	8304	1195	7
Nutrition	333	Null	232	257	305	339	352	422	321	422	232	2
Decent life+	928	Null	566	629.5	748	977.5	1187	1478	1981	1981	566	4
Health	60	Null	18	22	28	41	57	119	283	283	18	16
Mobility	226	Null	172	109.5	211	305.5	314	522	690	690	109.5	6
Social participation	523	Null	233	251	347	510	660	837	896	896	233	4
Education	41	Null	Null	Null	28	38	47	91	91	91	28	3
External FEW-Nexus related effects												
Ecological footprint in m2	6533	Null	3811	3923	5006	6213	7364	10083	13050	13050	3811	3.4
Water footprint in cbm	229	Null	123	132	176	218	259	369	554	554	123	4.5

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, Null = not enough data available, +) includes hot, cold and waste water costs IEK-STE 2020

Table 11 reveals some differences in the capability budget of the **single parents in comparison to the previous households**. The spread of the health (16) and mobility (6) functionings of the single parent

households is lower than that of the single households. This also applies to social participation and to some extent for education. In the case of education for the two lowest income groups no valid data are available. The spread for the nutrition and decent life is as low as for the single households, but the mobility spread is significantly lower. The mobility needs of this group are similar, independent of the earned income. This also applies to the external FEW-nexus related effects. The spread for the ecological footprint (3.4) and for the water footprint (4.5), i.e. the worldwide reach, shows no significant differences between the households according to their earned income.

The following table 12 reveals the capability budget of the **couple households without children**, where the analysis reveals a more evenly distributed welfare foundation. The justice spreads for all functionings are below 10, constituting the lowest spread of all analysed households. The highest spreads are identified for both the welfare foundation and health expenditures (both 9). Nutrition (2) and education (2) are the most evenly distributed functionings for the couples.

Table 12: Capability budget of couple households without children - 2018

Capability Budget of the German households - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	Monthly net income below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Couples without children							
Welfare foundation	4962	Null	1015	1300	1794	2358	3140	4594	8790	8790	1015	9
Nutrition	415	Null	299	315	339	363	400	427	474	474	299	2
Decent life+	1341	Null	Null	755	817	977	1290	1522	1963	1963	755	3
Health	173	Null	46	35	53	84	108	163	329	329	35	9
Mobility	442	Null	198	115	178	268	478	600	820	820	115	7
Social participation	807	Null	283	278	366	509	638	839	1246	1246	278	4
Education	11	Null	8	10	13	9	9	11	15	15	8	2
External FEW-Nexus related effects												
Ecological footprint in m2	9435	Null	4683	4453	5269	6432	7947	9796	13491	13491	4453	3.0
Water footprint in cbm	359	Null	137	130	162	217	279	401	553	553	130	4.2

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, Null = not enough data available, +) includes hot, cold and waste water costs IEK-STE 2020

Similarly, also the FEW-nexus related expenditures of this household group are below 10. The highest FEW-nexus spread is identified for the mobility functionings (7). The external FEW-nexus related effects show a spread of 3 for the ecological footprint and of 4.2 for the water footprint. Hence, the external effects are not so much influenced by the level of the household income.

In a next step, table 13 shows the capability budget of **couples with children.** On average, for these households the expenditures for the functionings are also more evenly distributed. Only the health expenditures differ significantly between the highest and the lowest income group. The justice spread is 12.

Table 13: Capability budget of couples with children - 2018

Capability Budget of the German households - 2018
Monthly expenditures for the households functionings and its external effects

Social functionings \ social groups	households,total	Monthly net income below 900	900-1300	1300-1 500	1500-2000	2000-2600	2600-3600	3600-5000	5000-18000	Max	Min	Justice spread
					Couples with Children							
Welfare foundation	6639	Null	1012	1246	1808	2388	3220	4684	8752	8752	1012	9
Nutrition	536	Null	325	357	392	449	474	518	585	585	325	2
Decent life+	1588	Null	285	296	821	927	1272	1572	2093	2093	285	7
Health	117	Null	18	15	30	42	51	79	174	174	15	12
Mobility	588	Null	265	195	191	335	513	587	876	876	191	5
Social participation	900	Null	306	285	319	447	572	768	1167	1167	285	4
Education	104	Null	Null	16	48	50	71	87	133	133	16	8
External FEW-Nexus related effects												
Ecological footprint in m2	11337	Null	Null	Null	5263	6731	8030	9962	14080	14080	5263	2.7
Water footprint in cbm	18916	Null	Null	Null	6471	10343	12692	16620	24728	24728	6471	3.8

Source: Own calculation 2020 based on German Federal Statistical Office, 2020, Null = not enough data available, +) includes hot, cold and waste water costs IEK-STE 2020

For all other functionings, the justice spreads are below 10 and, again, nutrition is the most evenly distributed functioning (2), followed by the ecological footprint spread (2.7) and the water footprint spread (3.8). Also the other FEW-nexus related functionings show a relatively low spread between the highest and lowest income group. Hence, these social groups have more similar household needs, which are more independent from the earned income as in other social groups.

The analysis so far has revealed heterogeneity in the capability budget across the household groups and their respective justice spreads. Hence, the different effects will now be summarized in the capability index for the various German household groups based on the equations of chapter IV.2.

IV.4 Revealed capabilities

The analysis reflects the heterogeneous picture of the German capability index (GCI) for the various households (table 14). The GCI measures the distribution of the capability budgets between the social groups and their functionings.

Our results reveal a great spread between the social groups over all functionings. The highest GCI is calculated for the group of single women and single men (0.469, 0.458), followed by the group of couples (0.376), and at a much lower level the single parents (0.274) as well as couples with children (0.164). These numbers result in an aggregated GCI for the average household of 0.248. The capability budget of the single parents and of the couples with children is smaller than that of the single households. Essentially this implicates that a single woman or a single man can make much better use of their functionings than members of the other household groups.

Table 14 German Capability Index

German Capability Index 2018 and the FEW-Nexus

per person of household - adjusted by household size

Functionings	All households	Single Woman	Single Man	Single Parents	Couples without children	Couples with children
Welfare	0.318	0.424	0.491	0.210	0.354	0.214
Nutrition	0.314	0.210	0.239	0.238	0.368	0.247
Decent life	0.348	0.551	0.486	0.237	0.374	0.217
Decent life Energy	0.237	0.304	0.271	0.190	0.274	0.155
Health	0.244	0.579	0.575	0.224	0.398	0.185
Mobility	0.342	0.480	0.582	0.238	0.383	0.227
Mobility energy (fuel)	0.282	0.420	0.516	0.217	0.353	0.214
Social participation	0.311	0.404	0.443	0.228	0.351	0.206
Education	0.341	0.425	0.425	0.319	0.245	0.251
Over all functionings	**0.248**	**0.469**	**0.458**	**0.274**	**0.376**	**0.164**
Indirect German Capability Index 2018						
FEW-Nexus (1-X)						
Ecological Footprint	0.525	0.597	0.585	0.444	0.231	0.125
Waterfootprint	0.353	0.776	0.770	0.172	0.133	0.023

Source: Own calculation, 2020 IEK-STE 2020

In the following, we analyse the six major groups of functionings. In the case of the **welfare functionings**, the single man has the highest index value (0.491), followed by the single women (0.424) and couples (0.354). The single parents (0.210) and couples with children (0.214) have the lowest index values. Given this data, we can conclude that the welfare basis of families with children is lower than that of single households and couples.

When look specifically at the **decent life functioning**, it shows that the social group of single women has the highest value (0.551), followed by couples without children (0.374) and single men (0.486). Families with children have significantly lower index values. Households with children have difficulties in achieving the same level of decent life as households without children. Their capabilities are limited by their functionings. When looking at the health functioning, three major groups of households are

identified. The CGI of single households is more than twice that of the households with children and of couples without children.

As discussed above, the FEW-nexus can be characterized by the energy, mobility and nutrition functionings.

The analysis of the **functioning nutrition** reveals that couples without children have the highest value (0.368) and the single woman households have the lowest value (0.210), whereas the other household groups have more or less similar values. The **energy functionings** for a decent life show a similar distribution as the decent life results, but the values are on average a little lower. The spread between the highest and the lowest value is smaller, i.e. the energy capability budget is more evenly distributed.

Also for the **mobility functioning**, a very heterogeneous picture of German households is revealed. In the case of mobility, the single man households have the highest GCI value (0.516) followed by single women and couples. The index is significantly lower for families with children, implying that these families on average have less mobility options than the other households.

This has further implications for the **social participation** options **of the households**. Single men, single women and couples have a significantly higher opportunity to use their capabilities in the social participation process. Families, in contrast, have limited social participation options as indicated by their low CGI. The data show that families generally save their capabilities for the **education functioning**. Their values are much higher than those of the single households. They focus their functionings to provide their children better capabilities and a better life in the future. Accordingly, in their capability budget the functioning education has a significantly higher value than the other functionings. Our finding confirms the central assumption of Sen that the capability approach includes explicit value judgements which differ from person to person (Deneulin and Shahani 2009; Sen 1999) and can be revealed by the GCI.

The analysis of the indirect German capability index shows that the impact of the single households on the local and global water resources is much lower than of the other households, as reflected in the highest CGI for the water footprint by single women (0.776) and single men (0.770). The single parents and the couples have significantly lower GCIs, so that the water footprint GCI of the average German household is 0.353. This average household value is lower than the CGI value for the ecological footprint (0.525). That is, for the utilization of the general ecological resources the GCI values are lower for the average households than for the usage of the local and global water resources.

The differences between the various households of the analysed social groups become smaller when considering the total environmental impact of the households' consumption patterns. The GCI of single households is very similar between women and men (0.597, 0.585), whereas for the single parents (0.444), couples with (0.125) and without (0.231) children, the index decreases, resulting in an overall average household value of 0.525. In summary, these numbers show that the average impact of the households on the environment is lower than on the global water system.

V Conclusion – the worldwide reach of German households

We showed that functionings are constitutive of a person's well-being (Sen 2007). Furthermore we analysed the functionings of German household groups. The presented analysis shows that people use their functionings differently to realize their capabilities and that they have distinct capability budgets. As expected, the budget of households with children is more limited than that of single households and couples. Family households focus their functionings more strongly. They have a clear priority for education, i.e. on the future well-being of their children. We assume that families restrict their capabilities in some areas, as for example mobility and health, and focus more on education. The high values for health in the groups of single man and woman households is also caused by the fact that a large percentage of these households are retirees with necessarily higher health expenditures.

The analysis has also shown that the worldwide reach of the German households can be measured and that the impacts on the local and global water and ecological resources increase with growing income. The higher the income of the households the higher is the utilization and exploitation of global resources.

Sen's welfare concept expressed in his capability approach can be related to the global quest for sustainable development (Leßmann and Masson 2015). The presented analysis has shown that a capability-based sustainable development concept has to consider also the spatially distributed external effects imposed on the current generation around the globe. These effects influence the functionings of the people who provided the water and ecological resources of the German household consumption patterns. The analysis confirms the initially discussed assumption that society (analysed according to its household groups) and its households have to increasingly sustain itself as the ecological and water footprints become bigger and bigger with rising household income.

Hence in the sense of Kant and Rosa, our analysis reconfirms two important normative restrictions:

1. The respect for the capabilities and functionings of other people should be an objective law, the own consumption patterns affect other people's capabilities and functionings.
2. Act at any time so that your world in reach does not become continuously larger (Rosa 2017) at the expense of others.

Furthermore, the developed analytical approach systematically proved the immediate intra- und intergenerational connection between individual well-being and the pursuit of sustainable development.

VI Outlook on further research needs

Further research is needed to analyse the reasons for the continuously growing worldwide reach of the German households with rising income and social status. It should be analysed, to what extent the ecological and water footprints of the German households and their respective impacts on the FEW-Nexus sectors can be reduced through alternative consumption patterns or through institutional and governmental measures. Hence, more research is needed on the institutional implementation of the revised Hartmut Rosa imperative: Reduce the worldwide reach of the German households and their

consumption decisions without reducing the utility level of the German households. This research should include the whole value added chain of the production and consumption processes: From cradle to grave all relevant economic processes should be identified and captured.

Another research step is the dynamization of the German Capability Index model, to generate an image of the future worldwide reach of German households against the background of different institutional, political and economic measures set by the decision makers. This would enable a simulation of different future pathways initiated by the German institutions.

More in-depth research is needed on the management opportunities of the FEW-Nexus in accordance with sustainable development, thus without restraining the capabilities of current and future generations.

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