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How Much Environment Do Humans Need? Evidence from an Integrated Online User Application Linking Natural Resource Use and Subjective Well-Being in Germany

Johannes Buhl [1,*], Christa Liedtke [1,2] and Katrin Bienge [1]

[1] Wuppertal Institute for Climate, Environment and Energy, 42103 Wuppertal, Germany; christa.liedtke@wupperinst.org (C.L.); katrin.bienge@wupperinst.org (K.B.)
[2] Department of Industrial Design, Folkwang University of Arts, 45224 Essen, Germany
* Correspondence: johannes.buhl@wupperinst.org

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Abstract: We present the results of a regression analysis of a large-scale integrated user online application that surveys natural resource use and subjective well-being in Germany. We analyse more than 44,000 users who provided information on their natural resource consumption (material footprint) as well as their personal socio-economic and socio-psychological characteristics. We determine an average material footprint of 26 tonnes per person per year. In addition, we endeavour to determine how much environment humans need by regressing natural resource use as well as relevant socio-economic and socio-psychological features on subjective well-being. We establish a slightly negative correlation between subjective well-being and material footprints. A higher material footprint is associated with lower subjective well-being. We conclude that consumer policies seeking to promote sustainable behaviour should highlight the fact that a lower material footprint may result in greater subjective well-being.

Keywords: material footprint; resource use; subjective well-being; life satisfaction; survey; data mining; online application; regression analysis

1. Introduction

As early as in 1994, Friedrich Schmidt-Bleek [1] wondered “How much environment do humans need?”. Although Schmidt-Bleek was unable to answer this question himself, he did introduce an indicator for ecological economics—the Material Input Per Service unit (MIPS)—that enabled later researchers to provide empirical answers to his question. Over twenty years later, Stefan Bringezu, Friedrich Hinterberger and Christa Liedtke challenged researchers to find an answer to Schmidt-Bleek’s question in a special issue of the *Resources* journal called “How much environment do humans need?”. In addition to advancing MIPS [2], the issue also answered the question of how much environment humans may consume if their resource use is to remain sustainable. The answer was approximately 8 tonnes per person per year up to the year 2050 [3]. And yet the original question—how much environment do humans need—has yet to be answered.

Recent research has attempted to answer this question by linking subjective and individual well-being to greenhouse gas emissions (GHG) [4,5] or carbon footprints [6]. Lenzen and Cummins [4] determined increasing but diminishing GHG emissions with increasing subjective well-being (SWB). However, they concluded that their “premature” findings were based on flawed data consisting of two independent datasets—one on GHG emissions and the other on subjective well-being and other socio-economic characteristics. They recommend that future research should (1) be based on a single sample population comprising environmental indicators and information on subjective well-being;

(2) involve an in-depth analysis of additional environmental indicators such as water use or material flows. Andersson and colleagues [5] succeeded in examining the link between subjective well-being and GHG from a single sample population in Sweden consisting of 1000 respondents. They determined a weak but positive relationship between subjective well-being and GHG, corroborating the 'premature' findings by Lenzen and Cummins [4]. Chenoweth and colleagues [7] examined the link between water consumption and subjective well-being based on a survey of households in England. They found no significant correlation between water use and subjective well-being.

Other studies have relied on macro data to examine the relationship between well-being and environmental impacts. Above all, Dietz and colleagues [8] examined the relationship between the ecological footprints of nations and life expectancy. They consider life expectancy to be a valid proxy for well-being because it is widely accepted as an indicator of a more general notion of well-being that comes with health and longevity and, furthermore, simply because it is a widely used indicator in national demographic statistics. Dietz and colleagues found no significant correlation between environmental impact (ecological footprint) and well-being (life expectancy) across 135 nations. More recently, in contrast to the reliance of previous studies on cross-sectional data, Apergis [9] examined 58 countries between 2005 and 2014 using statistically more powerful panel regressions. He even found a negative relation between GHG and subjective well-being. As a measure of individual life satisfaction, Apergis used responses to the question of "How satisfied are you with the life you lead?" on a Likert scale from (1) not satisfied at all to (4) very satisfied. In a more recent study based on micro data from a cross-sectional survey in Australia, Ambrey and Daniels [6] likewise determined a weak negative relationship between carbon footprints and subjective well-being.

The small but growing body of empirical studies on the relationship between environmental impact indicators and indicators of happiness, subjective well-being or life satisfaction presents no clear picture. Empirical findings range from weak positive to weak negative correlations, based on both micro and macro data, as well as cross-sectional and longitudinal data. However, we consider the findings by Dietz and colleagues [8] on the relationship between life expectancy and the indirect or proxy measurement of subjective well-being to be out-dated, as are the 'premature' findings by Lenzen and Cummins [4] based on different samples on GHG emissions and well-being. More recent, powerful studies by Andersson et al. [5], Ambrey and Daniels [6] based on micro data or Apergis [9] based on longitudinal macro data suggest that there is no relationship between environmental impacts and subjective well-being, or even a negative relationship. We therefore posit that there is no significant correlation between environmental impacts and well-being.

We contribute to the growing body of literature by providing evidence from a large-scale integrated online user application from Germany (ressourcen-rechner.de/?lang=en). We mainly extend the existing literature by investigating the relationship between GHG emissions and well-being. This investigation is carried out by conducting an in-depth analysis of the relationship between the use of natural resources and subjective well-being based on an integrated dataset on individual resource use, subjective well-being and socio-economic and socio-psychological dimensions. By doing so, we truly provide an answer to Schmidt-Bleek's [1] question "How much environment do humans need?".

We start by introducing the data and methods used in the next section. After presenting the results in Section 3, we discuss and analyse the findings and offer policy advice in Section 4.

2. Data and Methods

2.1. Data

The material footprint is calculated on the basis of the life-cycle material input of all goods and services used by the household (see [2,3] for a more extensive methodological description). Natural resource categories are equivalent to total material requirement (TMR), including abiotic and biotic material resources (also their unused extraction), and erosion in agriculture and forestry, which is usually used in national, comparative, macro studies (see [10]). The calculation procedures used here, however, are based on life-cycle material flow calculations of products and activities. As such, they enable a more differentiated picture of the natural resource use of private household consumption to be derived. The material resource use by households includes any natural material resources required for (1) producing and using materials, products, and services for private consumption; (2) any other activities performed by or covering household needs; (3) disposing of those materials and products. The material footprint includes the weight of all natural raw materials required for private consumption. For car travel, for example, not only are the car and fuel considered, but also the iron ore mine, the steel production factory and the infrastructure (i.e., roads).

The overall amount of raw materials can be used to estimate the pressure on the environment—from the extraction of raw materials to recycling processes or the disposed resources as waste. Since secondary materials mainly generate lower material footprints, the footprints of products, services and activities can be decreased by increasing the amount of secondary material per product or service. Decreasing resources follows the precautionary principle—the fewer natural resources are used and consumed, the lower the impact on the environment in the long run. In this respect, the Sustainable Development Goals (SDGs) suggest using the per-capita material footprint to measure the sustainable management and efficient use of natural resources for Goal 12, which seeks to ensure sustainable consumption and production patterns. SDG indicators are generally supposed to differentiate between income, age, sex, race, ethnicity or country ([11], Annex III). Only indicators based on micro data allow differentiated conclusions to be drawn on individual or household characteristics to be derived; as such, they address different population and consumer groups. In our study, private consumption is divided into the following components:

- Nutrition, including diets, food waste and all the foodstuffs and drinks consumed;
- Building and housing, including the use of energy (electricity and heating) for household purposes;
- Consumer goods, including clothes, furniture, household appliances such as fridges and washing machines, consumer electronics such as TV sets and tablets;
- Mobility, including everyday mobility such as commuting and leisure activities by car, motorbike, bicycle and public transport;
- Leisure activities, including hobbies such as sports and cultural activities;
- Vacations, including travel and accommodation.

The web application also mined anonymised information on users' socio-economic and socio-psychological characteristics. Socio-economic information includes gender, age, years of schooling according to the International Standard Classification of Education (ISCED) and social status based on occupational status. Household characteristics include information on household size, the number of children living in the household, living space and size of community. Subjective assessments and norms include relative household income (household income compared with peers and friends), subjective health (how healthy the respondent feels), social relations (frequency of satisfying social ties with family and friends), as well as subjective well-being. The measure of subjective well-being is a single question evaluative measure on individual life satisfaction ("All things considered, how satisfied are you with your life as a whole these days?") measured on a 10-point bipolar scale from (1) completely dissatisfied to (10) completely satisfied with life as suggested by the Organisation for Economic Co-operation and Development (OECD) [12,13]. In the following presentation of methods and results, we—more accurately—refer to life satisfaction as subjective well-being since we operationalise subjective well-being using a global life satisfaction scale as suggested by the OECD.

In addition, we consider all resource-intensive activities and lifestyles separately. Such factors include diets, distances travelled on trips, and days on vacations. By taking this approach, we consider the relevant dimensions that may influence individual life satisfaction. According to Enste and Ewers [14], these dimensions are age, gender, subjective health, unemployment, income and social relationships (number of friends, family status). Instead of taking into account any socio-psychological information, Andersson et al. [5] considered resource-intensive activities such as air travel, size of residence, non-work-related driving and number of meals including red meat consumed per week. Table 1 provides an overview of the data and information that was included in the further analysis of the relationship between material resource use and life satisfaction. They included personal characteristics, household characteristics, subjective assessments, various variables describing the user's lifestyle and the corresponding material resource use (in terms of the user's material footprint).

Table 1. Overview of variables and descriptive statistics of the data.

Statistic	N	Mean	Std. dev.	Min.	Max.
Personal characteristics					
Female	26,103	0.62	0.49	0	1
Age	24,596	36.00	12.00	18	71
Years of schooling	26,118	14.00	3.20	9	21
Occupational status	18,463	3.00	1.10	1	4
Unemployment	18,463	0.14	0.35	0	1
Household characteristics					
Household size	44,238	2.20	1.00	1.00	6.00
Number of children	9119	1.60	0.71	1	4
Size of dwelling (m^2)	30,482	95.00	47.00	7.00	300.00
Subjective assessments					
Subjective health	17,297	1.30	0.57	−1	2
Relative income	22,125	−0.41	1.00	−2	2
Life satisfaction	26,041	7.30	1.80	1	10
Satisfaction with social ties	17,690	1.00	0.71	−2	2
Lifestyle					
Diet	44,317	2.20	0.84	1	4
Vegetarian	44,317	0.33	0.47	0	1
Hours spent on hobbies	44,091	8.00	12.00	0.00	75.00
Days on vacation	44,056	15.00	13.00	0	81
Trips (in km)	44,086	220.00	327.00	0.00	1800.00
Material footprint (kg)					
Housing	44,068	8722.00	4059.00	45	26,804
Consumer goods	44,068	2859.00	1161.00	2	6936
Nutrition	44,068	5160.00	1323.00	82	9145
Leisure	44,069	446.00	639.00	0	5113
Mobility	43,456	6682.00	6407.00	1	39,447
Vacations	44,068	1525.00	1532.00	0	10,200
Overall material footprint	44,068	25,897.00	10,041.00	2711	76,570

Note: descriptive statistics include the number of observations (N), mean, standard deviation (Std. dev.), minimum (Min.) and maximum (Max.) number of observations. "Trips" represents the distance travelled in km for trips and events over the past month. "Days on vacation" stands for the total number of days on vacation in the past year. "Hours spent on hobbies" represents the average total number of hours spent on hobbies per month. "Satisfaction with social ties" is the personal evaluation of how often social relations are perceived as satisfying (on a Likert scale). "Relative income" is the comparative assessment of the household net income (on a Likert scale).

We collected data from an online survey application at ressourcen-rechner.de/?lang=en. This application can be used to calculate a person's individual material resource use. Once their material resource use had been calculated, we asked users to provide additional socio-economic and socio-psychological information about themselves (see Table 1 for the relevant variables). The application was advertised on the Wuppertal Institute website, by independent online blogs on sustainable living, and in reviews of economic and product testing magazines. The application can be used for free; no incentives are involved, and participation is voluntary. A total of 49,037 persons participated in the survey between its launch on 25 February 2015 and 13 February 2017. After preparing the data and removing invalid and implausible responses, information provided by 44,514 users was analysed. The differing number of observations between single variables is due to implausible responses and missing data due to non-response. We censored the data on material footprints and lifestyle (trips, days on vacations and hours spent on hobbies) as well as on age, size of residence and number of children in the household at the 99th percentile. In other words, we excluded the highest one per cent of observations of the distribution in order to cope with outliers and implausible responses. We also considered scores of 0 for material footprints for mobility and consumer goods to be implausible, and excluded them from our analysis. As a result, the total average material footprint is 26 tonnes per person. In comparison, findings from a recent representative analysis of the material resource use in private households in North Rhine-Westphalia, Germany's largest federal state, reported an average material footprint of between 30,992 kg and 31,721 kg in 2013 ($p < 0.05$), which is up to 23% higher than predicted in our study [15]. The distribution of the material footprint is close to normally distributed (Figure 1). The distribution of individual life satisfaction is skewed to the left (Figure 2). On average, respondents stated a life satisfaction of 7.3 on a scale from 1 to 10. This score is close to the life satisfaction in Germany determined by Enste and Ewers [14].

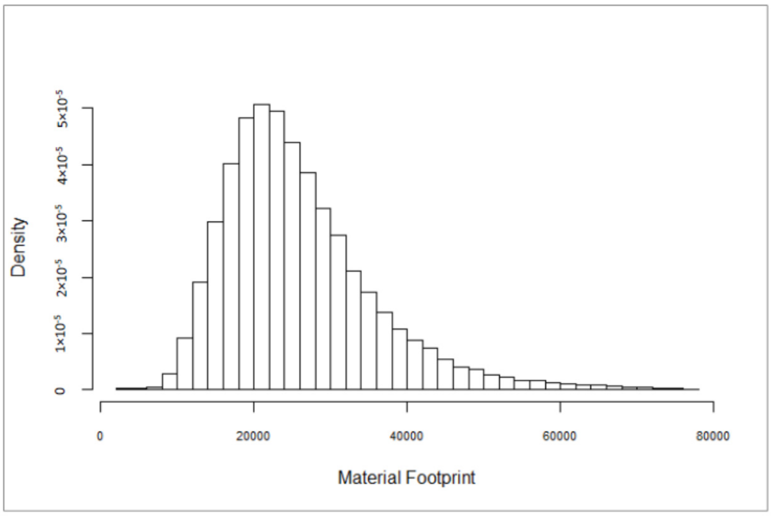

Figure 1. Histogram of the material footprint (in kg).

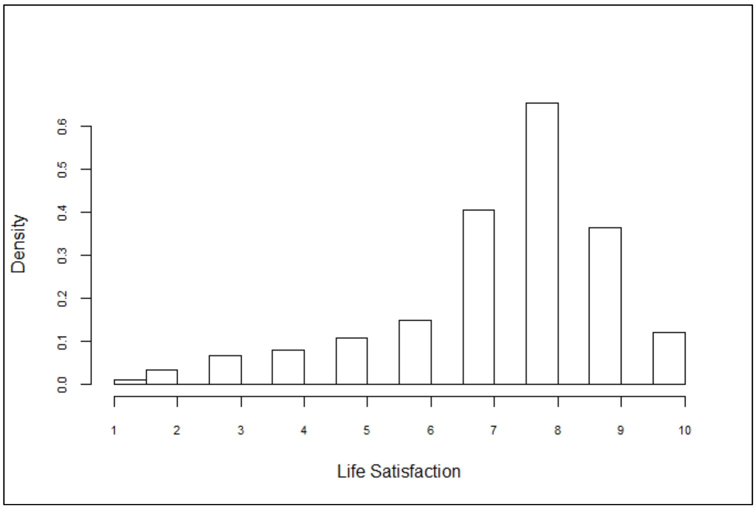

Figure 2. Histogram of life satisfaction.

How, then, does resource use (material footprint) relate to subjective well-being (i.e., life satisfaction)? The bivariate correlation plot suggests no clear link between material footprint and life satisfaction (Figure 3). This underpins our original hypothesis that there is no significant relationship between resource use and subjective well-being.

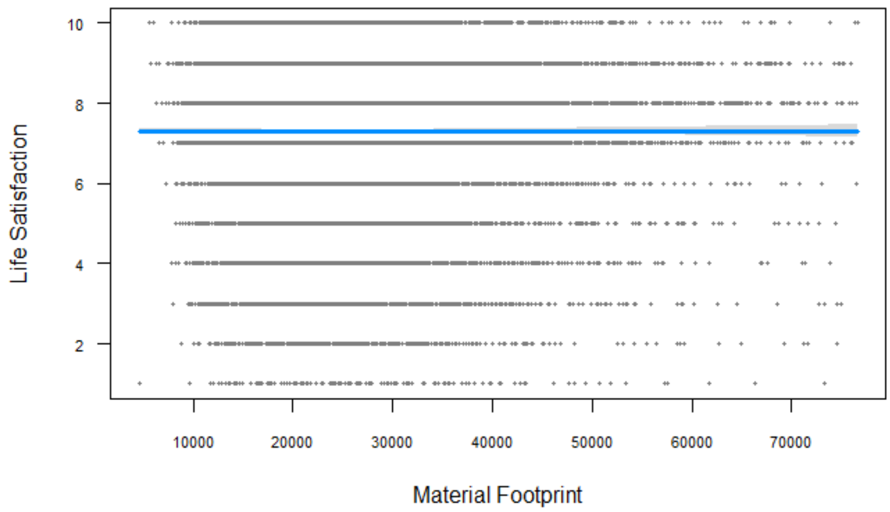

Figure 3. Scatter and line prediction plot of material footprint (in kg) vs. life satisfaction. Confidence band with $a = 0.01$.

2.2. Methods

In order to test our hypothesis, we regress the material footprint on life satisfaction, controlling for personal characteristics, household characteristics and additional lifestyle characteristics, as presented in Table 1. Based on Enste and Ewers [14] and Andersson et al. [5], we assume no non-linear relationship between predictors and the outcome variable (life satisfaction). Plotting residuals vs. fitted values of the final model corroborates this (see Figures A1–A4 for regression diagnostic plots). We set up the final linear model as follows:

$$y_i = X_i + Z_i + V_i + W_i + \varepsilon, \tag{1}$$

where

y_i: life satisfaction of user i
X_i: material footprint
Z_i: personal characteristics
V_i: household characteristics
W_i: lifestyle
ε: error

As indicated by the skewed distribution of life satisfaction (see Figure 2), we violate the assumption of normally distributed residuals of parametric t-tests. Accordingly, we transformed life satisfaction according to the Box–Cox transformation. Box and Cox [16] suggest transforming the response or outcome variable y in order to improve the symmetry of the distribution of y. To this end, a left-skewed distribution, such as with life satisfaction, needs its left tail pushed to the right and its right tail pushed to the left. Box and Cox define a suitable transformation as follows:

$$y_i^{(\lambda)} = \begin{cases} \frac{y_i^{\lambda}-1}{\lambda}, \; if \; \lambda \neq 0 \\ \ln(y_i), \; if \; \lambda = 0 \end{cases} . \tag{2}$$

Transforming y according to Box and Cox assures that $\lambda > 1$ shifts the outcome variable to a lesser extent in the long left tail and increases when progressing through the shorter tail, while preserving the order of the values of y such that a left-skewed distribution appears to be more symmetric. We estimate the maximum likelihood of y, assuming constant variance of y, and as such estimate normally distributed residuals as required.

We introduce the transformed variable as the outcome variable into Equation (1) such that the residuals are more normally distributed, the *t*-tests are not as biased, and skewness improves from −1.48 to −0.47 in the following model:

$$y_i^{(\lambda)} = X_i + Z_i + V_i + W_i + \varepsilon. \quad (3)$$

Note that the interpretation of the power-transformed outcome variable does not change its meaning since subjective well-being is operationalised as a quasi-metric scale (just as a length m changes its meaning to an area m^2, for example). Subjective assessments such as the statement of relative income have been operationalised as equidistant and thus quasi-metric Likert scales. Categorical variables such as gender, occupational status and diets have been introduced to the model as dummy variables. Further diagnoses of heteroscedasticity (scale location plots) and multicollinearity (variance inflation factors) revealed no effects on the assumptions relevant to linear regression and parametric *t*-tests (see Appendix A for diagnostic plots). We consider linear, multiple ordinary least square (OLS) estimates of the relationship between individual life satisfaction and material resource use, controlling for relevant covariates to be the most efficient and consistent best linear unbiased estimation (BLUE).

3. Results

We present results from a stepwise regression analysis. We present four models to determine mediations between variables and to check the robustness of the effects (see Table 2). In the first model (1), we estimate the relationship between the overall material footprint or the material footprint for leisure and life satisfaction. In the second model (2), we introduce additional covariates which we know may influence life satisfaction to a relevant extent and may thus mediate or better explain life satisfaction than resource use alone. Such covariates are, above all, subjective norms and assessments such as subjective health, satisfaction with social ties, relative income, and social status based on occupational status. In the third model (3), we introduce socio-demographic individual and household characteristics, i.e., gender, age, years of schooling, size of household and size of dwelling. In the fourth and final model (4), we introduce further lifestyle variables such as diets, time for hobbies, trips and days on vacation, which proxy resource-intensive lifestyles or activities as introduced by Anderson et al. [5] in their study on the effects of carbon footprints on subjective well-being. Altogether, we find that the stepwise regression conducted by Anderson et al. [5] is a viable way to determine and describe the relationship between environmental pressures on life satisfaction; we therefore follow their stepwise approach.

In Table 2, we present the results from regression analysis of the stepwise regression encompassing four successive regression estimates. The fourth model is the decisive, final model for assessing the relationship between resource use and life satisfaction. As we can see, the material footprint correlates significantly with life satisfaction throughout the stepwise regression analysis. The significant effect of the material footprint of leisure is a statistical artefact that dissolves as soon as additional covariates are introduced into the model (2). However, the correlation between the overall material footprint and life satisfaction is a robust, significant effect throughout models (2) to (4). Interestingly enough, the effect of resource use on life satisfaction is negative. This means that as the material footprint increases, life satisfaction decreases. Our results support the recent findings by Ambrey and Daniels [6], who also established a negative relationship between environmental pressures and subjective well-being.

As expected, subjective health, satisfaction with social ties, and relative income have a significant influence on life satisfaction. The healthier they feel, the more satisfying respondents perceive their social ties to be; the higher respondents rank their household income compared to friends and families, the higher their individual life satisfaction. Social status based on occupational status has a significant effect. Unemployment had a positive impact on life satisfaction in model (2). However, the significant influence of unemployment dissolves as additional personal covariates are introduced to models (3) and (4). Eventually, social status based on occupational status has no robust, significant influence on life satisfaction. Nonetheless, we would have expected unemployment to have a significant negative influence on life satisfaction, as shown by Enste and Ewers [14]. This leads us to ask which the most relevant predictors for explaining life satisfaction are. In order to reveal and compare the power of predictors, we need to standardise our regression coefficients since we have to deal with different scales, ranging from quasi-metric Likert scales such as subjective health to metrics such as age and, above all, large-range material footprints.

Table 2. Results from the stepwise regression analysis of the material footprint on life satisfaction.

Variable	Life Satisfaction			
	(1)	(2)	(3)	(4)
Material footprint	−0.00003	−0.0001 **	−0.0001 ***	−0.0002 ***
	−0.00003	−0.00004	−0.00004	−0.00004
Leisure Footprint	0.004 ***	−0.0002	0.001	0.0001
	−0.0004	−0.001	−0.001	−0.001
Subj. health		16.558 ***	17.146 ***	16.773 ***
		−0.577	−0.596	−0.608
Social ties		17.330 ***	17.132 ***	16.902 ***
		−0.484	−0.502	−0.512
Rel. income		5.794 ***	5.438 ***	5.370 ***
		−0.453	−0.469	−0.478
Unemployment		2.701 ***	1.401	1.387
		−0.927	−1.036	−1.056
Female			1.950 ***	2.185 ***
			−0.701	−0.722
Age			0.261 ***	0.258 ***
			−0.031	−0.032
Years of schooling			0.002	−0.062
			−0.105	−0.108
Household size			0.359	0.044
			−0.449	−0.464
Dwelling (in m^2)			0.049 ***	0.057 ***
			−0.009	−0.01
Vegetarian				0.213
				−0.715
Hobbies (in h)				0.048
				−0.03
Trips (in km)				0.002
				−0.001
Vacations (in d)				0.082 ***
				−0.026
Constant	91.020 ***	59.584 ***	44.316 ***	44.764 ***
	−0.713	−1.304	−2.497	−2.581
Observations	25,676	11,757	11,093	10,788
R^2	0.003	0.209	0.22	0.22
Adjusted R^2	0.003	0.208	0.219	0.218
F statistic	39.888 *** (df = 2; 25,673)	516.554 *** (df = 6; 11,750)	283.993 *** (df = 11; 11,081)	202.026 *** (df = 15; 10,772)

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors in parentheses.

Figure 4 presents the beta standardised predictors in a coefficient plot. We only show the statistically significant effects ($p < 0.01$) in decreasing order according to their power. Subjective health and satisfaction with social ties are by far the most powerful predictors of life satisfaction, followed by relative income and gender. Age, days on vacation, size of dwelling, and the material footprint have a relatively weak influence on life satisfaction. Compared to all significant predictors, resource use seems to have the weakest influence on life satisfaction. Standardising coefficients supports our assessment of the relevance of the predictors based on explained variance (see adjusted R^2 in Table 2). Subjective health, social ties and relative income are the most relevant predictors of life satisfaction. Socio-demographic characteristics may be a much less relevant way to predict life satisfaction. Further characteristics of proxy resource use, such as size of dwelling and days on vacation, are even less relevant to life satisfaction such that the influence of the material footprint overall is the least important predictor of life satisfaction.

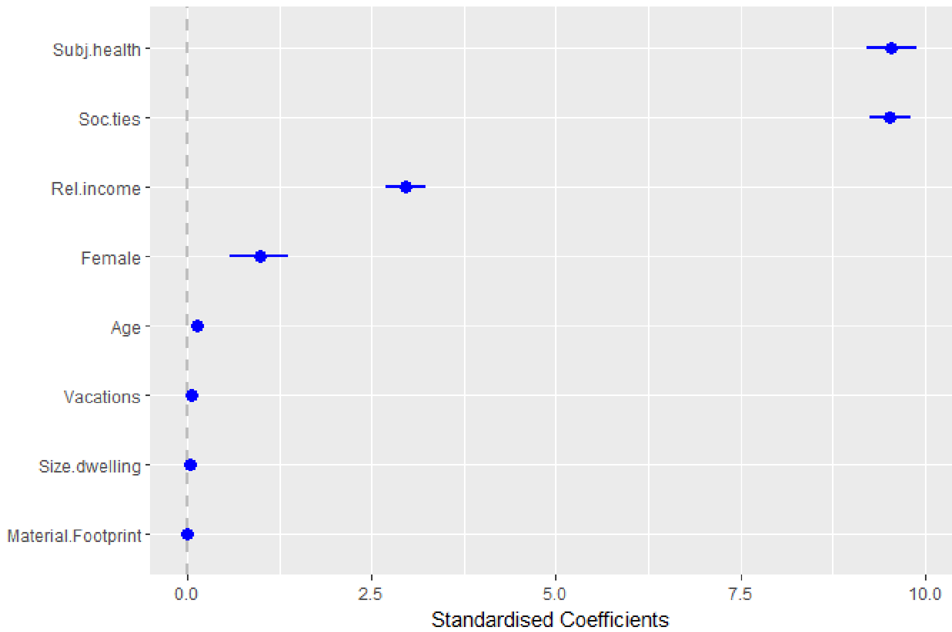

Figure 4. Standardised beta coefficients of significant predictors of life satisfaction ($p < 0.01$). Confidence is presented as standard deviance = 1.

4. Discussion and Conclusions

Our results from the stepwise regression of resource use on subjective well-being shows that there is indeed a relationship between resource use and subjective well-being, i.e., individual life satisfaction. Most importantly, we find a significant negative relationship between the material footprint and life satisfaction. As such, our results provide a clear-cut answer to the question of how much environment humans need: humans do not need larger material footprints to be more satisfied with their lives. Rather, the contrary is true. Our results support the recent findings by Ambrey and Daniels [6] that a decreasing overall resource use may lead to higher life satisfaction. However, our hypothesis and results may not be confused with a finding that *every* decrease in resource use may lead to higher life satisfaction. We rather find that different resource use in different areas of consumption may influence life satisfaction differently. Our analysis enabled us to predict the influence of resource use in different areas of consumption on subjective well-being for different population groups in terms of socio-economics or social-psychological characteristics of consumers and users.

However, our results only reveal weak evidence of a positive influence of resource-intensive activities, lifestyles and partial resource use for leisure on life satisfaction. Subjective health, satisfaction with social ties, and relative income are far more relevant and important to life satisfaction than resource use and other socio-demographic predictors. Subjective norms and assessments may predict life satisfaction more accurately than tonnes of resources used, square metres of dwelling or even days on vacation. Predicting and influencing subjective well-being is very much a matter of perceived good health, satisfactory social ties and a household income that is perceived to be higher than those of friends and peers. However, although our results rely on a large-scale online application and thus a large sample, we make no claim for representative predictions for Germany since our study was based on voluntary responses from an online application without rigorous sampling procedures. In spite of the large number of participants, our sample exhibits a selection bias towards young female users as well as a disproportionately high share of vegetarians and vegans [17]. The latter suggests a sample of users with pro-environmental attitudes and lower material footprints.

We therefore recommend that future studies should be conducted using a more representative analysis that is not as biased towards a pro-environmental sample in order to corroborate our findings. Moreover, despite a Box-Cox power-transformed OLS regression that is robust to non-normally distributed residuals, we are still confronted with a slightly left-skewed distribution of errors and, thus, potentially a slightly biased *t*-test. Nonetheless, in spite of a selection bias towards young female and pro-environmental users, we obtain useful insights into the non-existent positive and relevant correlation of resource use and subjective well-being. In contrast to previous studies, we provide results from a large-scale integrated online user survey application for a further indicator of environmental pressure—the material footprint. Our findings for Germany following an analysis of the influence of material resource use on life satisfaction support previous studies conducted in Sweden [5] and a study based on national statistics that established a non-significant and negative relationship between GHG emissions, the ecological footprint and subjective well-being [6,9].

Relevance for Consumer Policies

The findings are relevant for consumer policies. Consumer policies need not assume that decreasing resource use is associated with decreasing subjective well-being. Recently, consumer policies to promote sustainable behaviour have relied on insights from behavioural sciences in the context of innovations from information and communication technologies such as feedback, smart and automating technologies that are more effective at helping to 'nudge' consumers towards a more sustainable behaviour. In this regard, consumer policies emphasise the fact that people lack information and education, have unsustainable habits and daily routines, and may be incentivised to favour a more sustainable behaviour by eco-design, monetary savings or good health [17–20]. Based on our findings and evidence from recent research on the same issue, we argue that consumer policies should highlight the fact that greater resource use may not result in greater well-being. Instead, they should consider the fact that less material resource use may be associated with higher subjective well-being. Our findings may support the argument that, for example, a user-centred design of products and services may yield a greater acceptance of sharing, leasing or digital product and service innovations, decreasing resource use *without* having to refrain from using services such as mobility, leisure or consumer goods—and thus *without* a decrease in subjective well-being, but rather an increase. Once again, however, this finding does not mean it can be concluded that *every* decrease in individual resource use decouples from well-being. Instead, we conclude that options for decreasing resource use without decreasing well-being should be differentiated between consumer groups or lifestyles. Addressing different consumer groups using differentiated consumer policies enables potentials for resource conservation to be realised more effectively in private households (see [21] for two examples on how to differentiate material resource use between lifestyles in consumer science). As a result, future research should place greater emphasis on analysing the different effects of different resource use in different areas of consumption for different products and services on individual well-being. This would lead to more differentiated findings for the purpose of shaping consumer policies. For example, further analysis of integrated micro datasets could include a cross-consumption analysis. Does a decreasing resource use for vacations spill over to a decreasing resource use in mobility? Assuming it does, does this hold true for all consumer groups in terms of age or income? To this end, an integrated online survey application on natural resource use, subjective well-being, and socio-economic and social-psychological characteristics offers a promising tool for more precise and differentiated prediction and assessment considering different product and service groups as well as population groups. Moreover, online applications are effective at collecting user panel data over time series, making an assessment and evaluation of consumer and business policies *over time* more efficient, straightforward and unbiased. They facilitate a more efficient evaluation of the capacity of consumer and business policies to meet Sustainable Development Goals in terms of resource conservation and subjective well-being.

Author Contributions: Christa Liedtke, Katrin Bienge and Johannes Buhl conceived and designed the survey; Johannes Buhl analysed the data and wrote the paper; Katrin Bienge and Christa Liedtke contributed to the development of the paper.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Regression Diagnostics

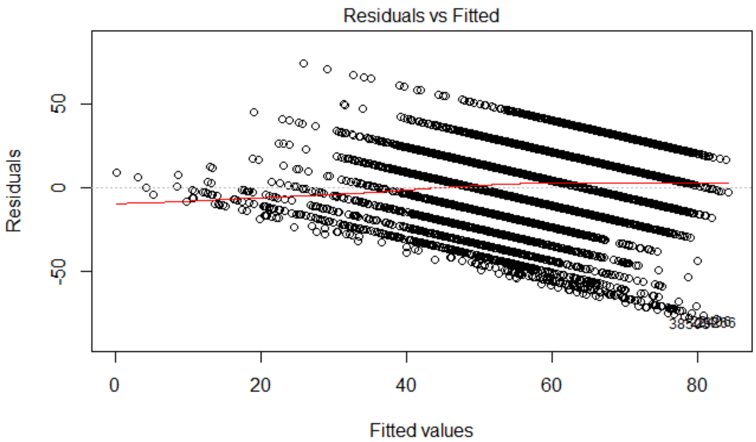

Figure A1. Residual vs. fitted—no non-linear relationship detected.

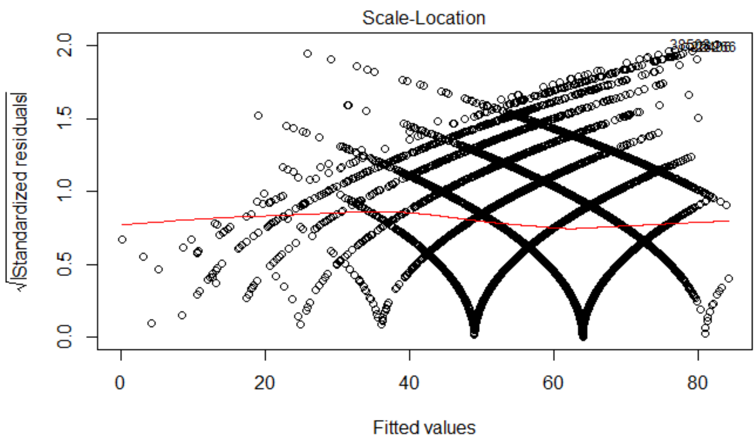

Figure A2. Scale location—no heteroscedastic pattern of residuals detected.

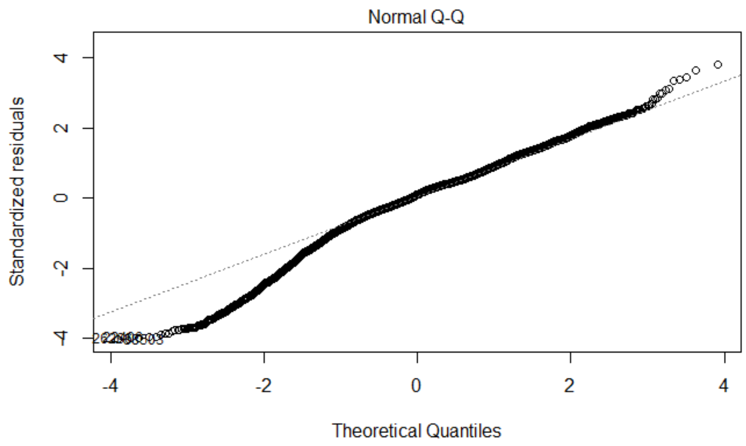

Figure A3. Normal Q-Q—no perfect normal distribution of residuals. Box–Cox transformation of outcome variable improved normality of residuals.

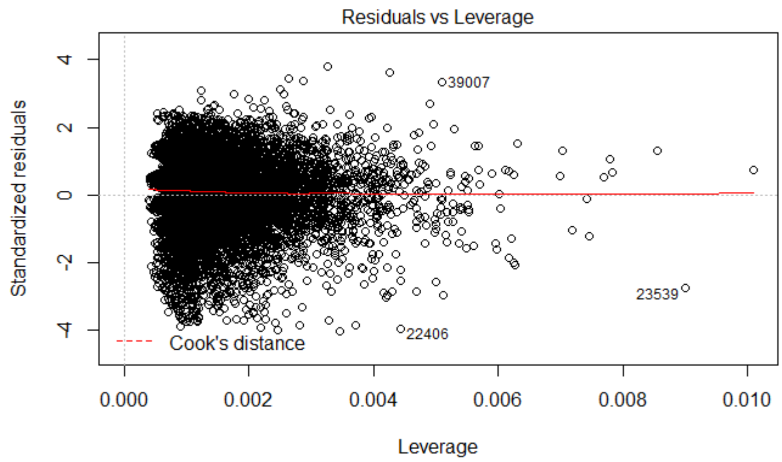

Figure A4. Cook's distance—no influential outliers detected.

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