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Article

Material Footprint of Low-Income Households in Finland—Consequences for the Sustainability Debate

Michael Lettenmeier [1,2,*], Tuuli Hirvilammi [3], Senja Laakso [4], Satu Lähteenoja [1] and Kristiina Aalto [5]

[1] D-mat ltd., Purokatu 34, 15200 Lahti, Finland; E-Mail: satu@d-mat.fi

[2] Wuppertal Institute for Climate, Environment and Energy, Döppersberg 19, 42103 Wuppertal, Germany; E-Mail: Michael.lettenmeier@wupperinst.org

[3] Kela, Research Department, P.O. Box 79, 00601 Helsinki, Finland; E-Mail: tuuli.hirvilammi@kela.fi

[4] Department of Environmental Sciences, P.O. Box 65, 00014 University of Helsinki, Finland; E-Mail: senja.laakso@helsinki.fi

[5] National Consumer Research Centre, P.O. Box 5, 00531 Helsinki, Finland; E-Mail: kristiina.aalto@ncrc.fi

* Author to whom correspondence should be addressed: E-Mail: michael@d-mat.fi; Tel.: +358-405-412-876.

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Abstract: The article assesses the material footprints of households living on a minimum amount of social benefits in Finland and discusses the consequences in terms of ecological and social sustainability. The data were collected using interviews and a questionnaire on the consumption patterns of 18 single households. The results are compared to a study on households with varying income levels, to average consumption patterns and to decent minimum reference budgets. The low-income households have lower material footprints than average and most of the material footprints are below the socially sustainable level of consumption, which is based on decent minimum reference budgets. However, the amount of resources used by most of the households studied here is still at least double that required for ecological sustainability. The simultaneous existence of both deprivation and overconsumption requires measures from both politicians and companies to make consumption sustainable. For example, both adequate housing and economic mobility need to be addressed. Measures to improve the social sustainability of low-income households should target reducing the material footprints of more affluent households. Furthermore,

the concept of what constitutes a decent life should be understood more universally than on the basis of standards of material consumption.

Keywords: consumption; household; social sustainability; income; sufficiency; ecological sustainability; natural resources; MIPS; material footprint; ecological backpack

1. Introduction

Concern over ecologically unsustainable levels of private consumption has become prevalent during the past few decades in Western countries. Household consumption expenditure has increased in the EU-15 by almost one-third per person between 1990 and 2002. Households are also becoming smaller, so people tend to use more living space, energy and water and generate more waste per person [1]. This development increases the extent to which private households consume natural resources and is a driving force behind the current overuse of natural resources.

However, not all households are equal in terms of how much they consume. Previous research shows a clear connection between income level and the environmental impacts of consumption: people with less financial resources use less natural resources and cause less carbon emissions [2–6]. Therefore, we can assume that the material footprint of people living in low-income households is at a more ecologically sustainable level. Consequently, the conclusion could be made that since poor people are living at a more ecologically sustainable level, their poverty is justified. Nevertheless, all environmental policies aimed at reducing the present level of consumption should take account the economic needs of low-income households and ensure at least a decent standard of living for all members of society [7]. Sustainable development requires an awareness of the fact that ecological sustainability and social justice are inextricably linked [8]. Therefore, the aim of this paper is to evaluate both the ecological sustainability and the social sustainability of low-income households. The approach resembles the concept of "environmental space", which describes the amount of sustainable space between the equally shared maximum rate of consumption of global natural resources while still ensuring basic needs and human dignity [9]. By drawing from previous research on what constitutes an ecologically sustainable level of natural resource use, and by using reference budgets that illustrate the social minimum required for decent living, we discuss the possibilities for achieving both an ecologically sustainable and socially decent standard of living in Finnish society.

In this study, we measured the amount of natural resource used by private households, *i.e.*, their material footprints, based on the MIPS concept (material input per unit of service) [10,11]. The MIPS method measures natural resource use throughout the entire life cycle of products and activities by taking into account both direct and indirect material use [12]. Material footprints can be used as an indicator for comparing present levels of household consumption to long-term targets for ecological sustainability. In addition, we assessed if the consumption level of low-income households can be regarded as socially sustainable by comparing their material footprints with the material footprint of a woman below 45 years of age, based on a single household reference budget. We decided to study low-income households in the Finnish welfare state because, according to social policy goals, they

should be allowed to achieve a decent standard of living, while, according to previous research [2–6], they can be assumed to have lower material footprints.

We present and discuss the material footprints of each of the 18 low-income households in their entirety and the different consumption components that the households need to make ends meet. With respect to the ongoing discussion about what constitutes a socially and/or ecologically sustainable level of household consumption [3,7; in terms of energy requirements, see 4], we compare the material footprints of the participating households to the material footprints calculated for the decent minimum reference budgets [13] and to the material footprints of 27 different, more "typical" households at varying income levels [2], as well as to the material footprint of an average Finn [14]. In addition, to evaluate the ecological sustainability of a particular household's level of consumption, we compare its material footprint to the level of sustainable resource use, which we obtained based on the values originally published by Bringezu [15].

In the following section, we describe the framework for the study and assess the notion of ecological and social sustainability. Thereafter, we describe the methodology of the study and the MIPS concept for measuring the material footprint of various households. After displaying and discussing the results, we conclude by considering the contribution of these empirical results to the sustainability debate.

2. The sustainable Level of Household Consumption

Sustainable development requires integrating environmental and social aspects in a way that directs policy goals and societies to an ecologically sustainable and a socially flourishing future. Ecological sustainability means living within the limits of the supporting ecosystems: the level of natural resource use should not exceed the long-term carrying capacity of nature (see [12,15–18]). Social sustainability refers to a sense of equity, an awareness of sustainability, participation and social cohesion and it emphasizes that development policies and social policies should be handled in a just and equitable manner [19,20]. The goal of socially sustainable development is to ensure a decent standard of living for every human being around the globe. This requires "meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life" [21]. Socially sustainable policy goals are implemented in welfare states through various welfare programs. For instance, in Finland the social policy is aimed at supporting social inclusion and participation and ensuring a basic quality of life for all members of society by providing, for example, a minimum level of social benefits in cases of social risk, such as sickness or disability [22].

However, the present sustainability discussion lacks a profound understanding of what constitutes basic needs and a decent standard of living: What is to be ensured and sustained? What should we regard as "decent" (e.g., [23,24])? Basic needs refer, naturally, to the ability to satisfy different needs, such as the need for food and pure water, decent housing, energy and health care [25]. A decent standard of living is, nevertheless, a more complex concept, since it has to be assessed in each society in the relation to the requirements of the environment in which people live. Just as with the concept of deprivation, a decent standard of living is relative to the local community and society to which an individual belongs [26,27]. For instance, in affluent consumer societies such as Finland it includes

more material necessities and a higher standard for housing and nutrition than is regarded decent in poorer countries.

One concrete way to assess the idea of a decent standard of living in terms of household consumption is a reference budget. It sets a consensus-based standard for a socially acceptable and desirable standard of living in present society by defining those goods and services that all households (whether a single individual, a couple or a family) should be able to afford. Reference budgets describe the level of consumption regarded as necessary for all members of society. According to Bradshaw *et al.* [28], reference budgets take into account both basic material needs and the need for social participation. In Finland, an adequate standard of living has recently been defined in the decent minimum reference budgets. These budgets were established as part of a consensual process involving both consumers (n = 53) and experts and they are based on four types of households [29]. The consumption level of the reference budgets is relatively low compared to what Finnish people spend on average. For the purposes of this study, we have calculated the material footprints for all the commodities and activities that are included in the Finnish decent minimum reference budgets (see [29]). For example, the material footprint of a single woman below 45 years of age is 20 tonnes per person in a year [13].

The reference budgets are based on current consumption patterns and the goods on offer. In many countries (e.g., Great Britain, the Netherlands and Sweden), the budgets are updated regularly, because when economy grows and more commodities enter the markets, the amount of commodities included in the reference budgets also tends to increase [29]—leading to an increase in the natural resource use of households. The growing amount of commodities and activities that constitute the elements necessary for a decent standard of living is one example of how social sustainability is promoted without taking into account the environmental challenge that we are facing. So far, the social and environmental dimensions have usually not been successfully integrated in research, in policy documents or in practice, which has led to separate and even contradictory policy targets [19]. For example, poverty reduction often requires economic growth, which might lead to an increase in material use and environmental degradation.

However, sustainable development demands that social sustainability goals be formulated in an environmentally sound manner, acknowledging that ecological sustainability is a necessary foundation for a sustainable society [8,19]. Sustainable social policy goals ought to include a target to decrease the present over-use of natural resources by reducing the harmful environmental impacts of both the public sector and private households. In addition, the social policies of Western welfare states should acknowledge that overconsumption by the rich nations is one strong driving force behind the overuse of natural resources, and that the world's wealthy are causing serious ecological destruction in developing countries by supporting export-oriented production. In addition to the need for a more equal distribution of wealth on a national level, there is an urgent need for a more equal global distribution of wealth and a more equal use of natural resources [8,9,20,30]. Environmental justice means that intergenerational and intra-generational equity should be made congruent—on a global level [31].

Based on this future-oriented and equality-based perspective, research on material use has estimated the level of ecologically sustainable public and household consumption. One target for sustainable production and consumption has been to reduce material flows in the industrialised countries by a

factor of 10 by the middle of this century [12,32]. This would make it possible to cut global material flows in half, while doubling global prosperity: it would lead to an increase in global resource productivity by a factor of four [33].

Drawing on these projections, Bringezu [15] has substantiated the sustainable level of resource use for total material consumption (TMC)—including public consumption and capital formation—of European countries by calculating that an acceptable level of abiotic resource consumption would be approximately 6 tonnes per capita in a year. In addition, he argues that the present consumption of 4 tonnes of biotic resources could probably be maintained "under conditions of sustainable cultivation", whereas erosion should be reduced by a factor of 10 to 15 from the present level of 3 tonnes per capita [15]. Therefore, a sustainable level of total material consumption (TMC) for a European economy would amount to a maximum of approximately 10 tonnes per capita in a year.

At the level of a private household, a sustainable level of natural resource use would amount to 6 to 8 tonnes per person in a year. We estimated this level by acknowledging that in a sustainable economy, the shares of public consumption and capital formation might drop to 20–40% that of the present level (approx. 40–60% of TMC [34,35]), because household consumption could be seen as being more essential than public consumption and capital formation.

At the present level of household consumption and the material footprint generated by it, Finnish households exceed this sustainable level by a factor of 4 to 7. Previous research has estimated that the natural resource use of an average Finn is approximately 30 [36] to 40 [14] tonnes per year and that the biggest shares of this go to housing, food, everyday mobility and tourism [2,14]. In a pilot study designed to measure the natural resource use of private households, Kotakorpi *et al.* [2] studied 27 Finnish households, including single households and families, households from urban areas and the countryside, and households from various income levels. The results showed that the differences in the material footprints of the households ranged from 13 to 118 tonnes per capita per year, meaning that there is a factor difference of 9 between the households with the smallest material footprint and those with the largest material footprint, a factor that differed by 3 from average in both directions.

3. Methods

In this article, we present the material footprints of 18 single households. We sent the invitation letter only to single households because, on the one hand, a single household is the most common household size in Finland [37], and because, on the other hand, allocating the material footprint to the members of the household is unambiguous in the case of single households.

All participating households were in southern Finland and the occupant was on disability pension or basic unemployment allowance. They belonged to the lowest income deciles in society, since their income was between 400 and 1200 euros per month, whereas the average income level in Finland was 3040 euros in 2010 [38]. According to previous research, those living at a minimum income are often, relatively speaking, poor and they lack the necessities or consumption habits that are presently regarded as socially acceptable [39,40].

The natural resource use of the participating low-income households was calculated on the basis of two interviews with each household, and via consumption and standard of living questionnaires that the participants filled in during an approximately two-week period between the interviews.

The participants were asked to report their income and consumption expenditures: food, housing, household goods, energy use, transport, tourism and leisure. The list of household equipment provided in the decent minimum reference budgets [29] was adapted to fit the questionnaire and used when assessing the equipment of the households being studied. The data for tourism was collected from the previous year so as to have a common and standardized time scale. During the interviews, we were able to fill in information that was missing in the questionnaires. Because the interviews were conducted by visiting the participating households, we were even able to observe the number and types of household appliances that the participants had. The interviews thus improved the reliability of the data collection.

The natural resource consumption of the households was calculated as the material footprint [41]. The material footprint is based on the MIPS concept [10–12], which takes into account the entire life cycle of products and activities and includes direct resource use (used extraction) as well as indirect resource use (unused extraction) in relation to the benefit provided [42,43]. The material footprint is calculated by multiplying the direct resource consumption or other input (e.g., electricity or transportation) by a material intensity factor (MIT factor) specific to each input [41]. Most of the material intensity factors used for the calculations were based on previous research [2,41,44]. In addition, some MIT factors (e.g., for health care and hairdressing) were estimated for the purposes of this study.

We chose the material footprint based on the MIPS concept as a measure for assessing and comparing the ecological sustainability of the households for several reasons. First, the MIPS concept and the material footprint can provide a rough indication of the long-term ecological sustainability of consumption patterns when compared to estimates for a sustainable level of natural resource use (see also Section 1).

Second, the material intensity values and factors used here are based on micro-level, life-cycle inventories, which provide us with a realistic and holistic view of the entire life cycle [10,11]. In addition, measuring both direct and indirect resource use (used and unused extraction) (see [42,43]) strengthens the life-cycle perspective. This also means that the approach covers all material flows that are a part of the human economy, including the material flows required for providing energy. This makes the MIPS approach more complete than, for instance, an ecological footprint or a carbon footprint, even though the material footprint does not directly account for land use.

Third, as a micro-level calculation approach, the MIPS concept can be used for modeling the activities of specific households at a greater level of scrutiny than when using macro-level approaches such as MEFA (material and energy flow accounting, see [45]) or TMC (see above)—provided that a sufficient amount of data is available for modeling the households. In this study, the relatively good availability of public data on the resource intensity of household-related products and activities enabled us to employ the material footprint and MIPS approach. Earlier research projects in Finland [2,14,46,46–48] provided an adequate database for most of the data needed in this study.

In this paper, resource use is calculated using mass units of TMR (total material requirement). The TMR is the sum of abiotic and biotic resource use plus the topsoil erosion related to agriculture and forestry [11]. Hence, the TMR does not include the resource categories of water and air. Although we calculated these resource categories as a part of this study, we opted not to include them in the current article for two reasons. First, the way in which water resources and also climate-related

air are calculated is still the subject of much heated debate (see e.g., [42]), so that the contribution of this article would probably be less relevant in these fields. Second, the debate regarding planetary boundaries and a sustainable level of resource use is less advanced in the fields of water and air use than are Bringezu's [15] contributions to the debate regarding what constitutes a sustainable level of TMC.

We also compare the material footprints of low-income households to the material footprints of the decent minimum reference budgets [13]. In this study, we used the budget of a single woman below 45 years of age as a point of comparison. Another reference point is the material footprint of an average Finn, which is based on average statistical consumption data and, where this was available, on plausible data from case studies (see [14]). It would also have been interesting to compare the results of this study to the material footprint of households that especially consider themselves to be ecologically friendly. However, previous research has revealed difficulties in defining a precise material footprint for such households because even households that consider themselves to be ecologically friendly show widely varying levels of natural resource use [46].

4. Results and Discussion

4.1. Natural Resource Use of the Households

The material footprint of the participating single households ranged from 7 to 35 tonnes per year, which means there was a difference of a factor of 5 between the households that consumed the least and those that consumed the most (Figure 1 and Table 1). Without these two extremes, the material footprints would have ranged from 11.4 to 26.8 tonnes per year, which would mean a maximum difference of a factor of 2.5 only. Fourteen out of the 18 households had a material footprint ranging from 11 to 21 tonnes. By analyzing the questionnaires, we can identify the reasons why certain households have higher material footprints. Both persons at the very lowest and the highest end of the range represented exceptional households. The lowest material footprint belonged to a person (V8) who was homeless, which explains the low material use. The person with the highest material footprint (V12) received regular financial support from family members. The analysis revealed that all three persons with the highest material footprints used more resources by travelling and engaging in other special activities because they were not living solely on the social security provided by society.

The results show that six households exceeded the material footprint based on the example from the decent minimum reference budget, but they still stayed below the level of an average Finn (see Figure 1). The relatively higher material footprints of these households were due to travelling, renting a summer cottage and/or using a private car on a more regular basis. Only three of the households studied used significantly more resources than any of the decent minimum reference budgets [13]. Each of these three households had a sponsor enabling them to have a standard of living above that provided by the basic social security.

Figure 1. Material footprints of the households.

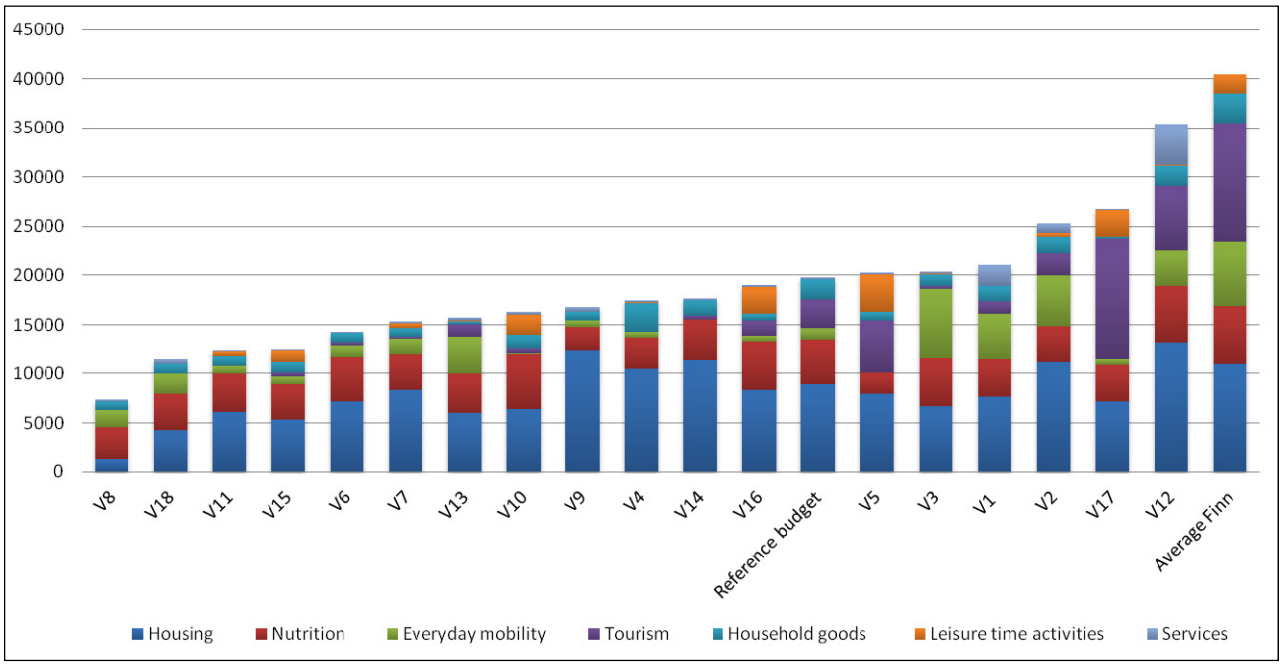


Table 1. Material Footprints of the households in kilograms.

	Low-income single households			References for comparison		
	Average	Average by %	Range	Reference Budget [29]	27 different households [2]	Average Finn [14,49]
Housing	7850	43	1300–13,230	8890	9400	11,000
Nutrition	3930	22	2130–5720	4570	4430	5900
Everyday mobility	1950	11	0–7160	1220	9900	6500
Tourism	1810	10	0–12,190	2890	9800	12,100
Household goods	1170	6	320–2890	2010	2400	3000
Leisure-time activities	780	4	0–3770	40	2900	2000
Services	600	3	0–4130	140	–	–
Total	18080	100	7390–35,380	19,760	38,830	40,500

When assessing all the consumption components (Table 1), housing made up the greatest share of the total, ranging from 1.3 to 13.3 tonnes per person in a year. Housing was followed by nutrition (which ranged from 2.1 to 5.7 tonnes), daily mobility (which ranged from 0 to 7.2 tonnes) and tourism (which ranged from 0 to 12 tonnes). This is understandable since both housing and nutrition constitute essential material needs: every person needs food and a place to live. The order of the consumption components is similar to that found in previous studies [2,3,36]. The other finding is that as the use of natural resources increases, housing and nutrition make up a lesser share of the total. Among the households consuming the least amount of resources, housing and nutrition comprised two-thirds of their total material footprint, whereas this share dropped to below half for households consuming the greatest amount of resources.

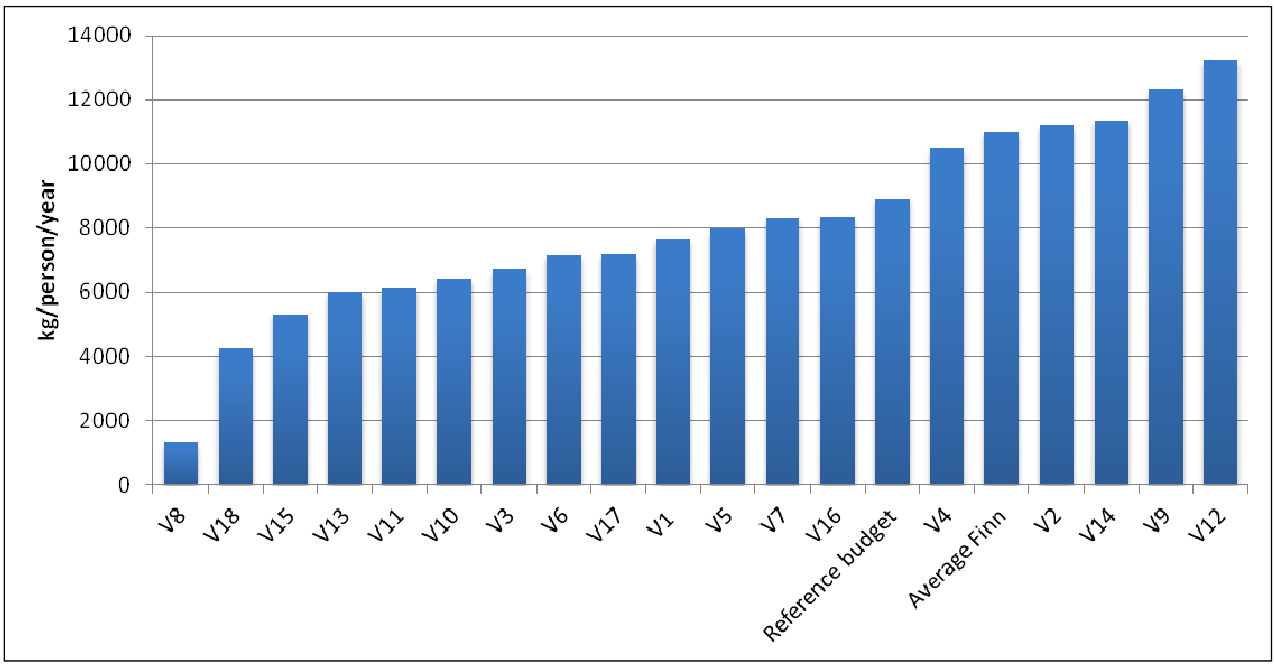
The differences between the material footprints of the households were larger in terms of daily mobility, tourism and leisure-time activities. For each of the consumption components, there were households with a material footprint of zero. This means that these households do not travel, do not

have special leisure-time activities and/or only walk for their daily activity—mainly as a result of their very low income.

In the following paragraphs, we more closely assess each consumption component. In addition, we compare the material footprints from our study with material footprints from other studies.

First, the results show that, at present, decent housing in Finland requires at least four tonnes of natural resources per person in a year (Figure 2); the lowest material footprint of 1.3 tonnes was the result of homelessness. The homeless participant was staying with friends, and therefore we calculated the material footprint based on daily energy consumption and a storage room for the person's goods rather than on all of the resources needed for the building. In all other cases, the TMR for housing consisted of the living space and its heating and electricity use.

Figure 2. Material footprints for housing.



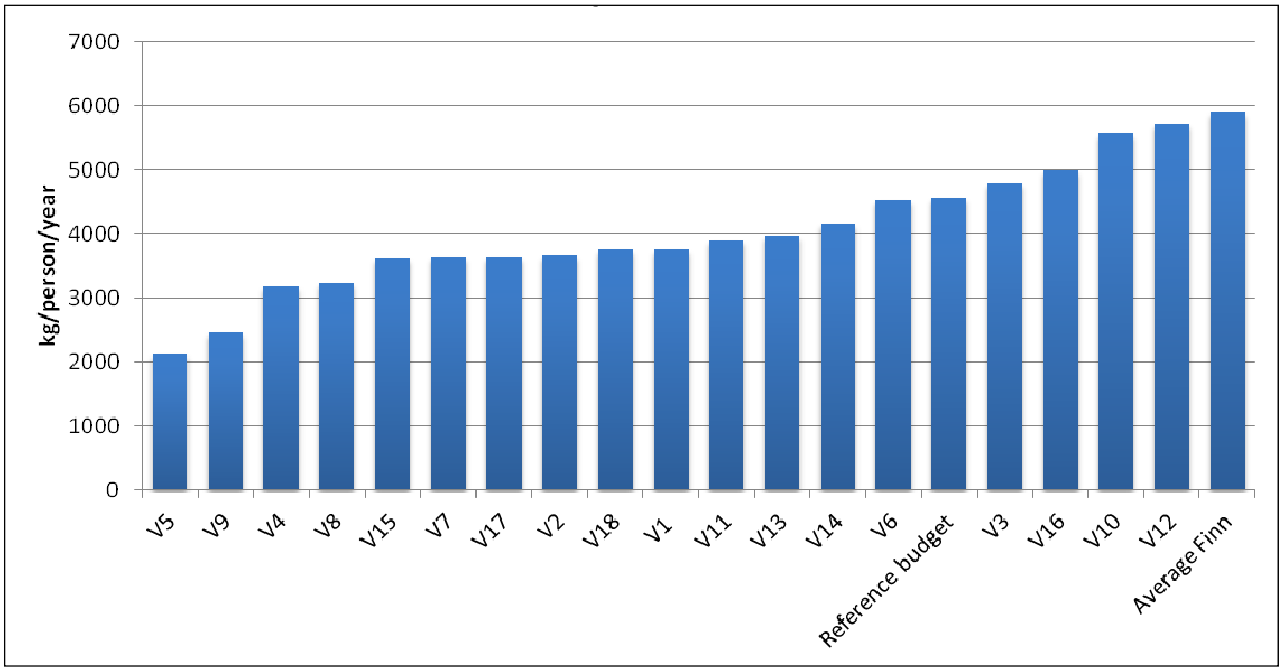
Most of the participants were living in studios or one-bedroom apartments, but one (V13) was living in a shared apartment and one (V18) in a service house. The average apartment size was 41 square meters. The amount of living space had the greatest effect on the material footprint for housing. This is partly due to the data used for the calculation: living space was also the basis for calculating how much heat a person consumed, because data on their actual heat consumption was not available.

Five of the households had material footprints for housing higher than the level of the decent minimum reference budgets and four exceeded the level for an average Finn. The material footprints for housing obtained in this study were roughly in the same range as the majority of the 27 households from different income levels studied by Kotakorpi *et al.* [2]. Only four households in that study had a material footprint for housing of more than 13 tonnes per person in a year, with a maximum of 39 tonnes. However, 21 of the households in the study were not single households; which usually decreases the material footprint of housing per person. In general, environmental impacts vary according to the size of the household, so that single households tend to have higher environmental

impacts due to their inability to share energy use or living space [3]. The findings also imply that housing standards and the housing infrastructure in Finland are relatively equal, because there are no considerable differences between the material footprints of low-income households and the material footprints of the decent minimum reference budget or those for an average Finn.

Second, the material footprints for nutrition ranged from 2.1 to 5.7 tonnes per person in a year (Figure 3). The footprints varied due to differences in diet, which supports the findings of previous research [3]. Among the households studied, the participant with the lowest material footprint (V5) was a vegan, whereas all of the other participants were meat eaters. The highest material footprint belonged to a participant who suffered from several diseases, causing to eat more often than normal: he had a special diet and used food supplements. Since several participants ate the same meal for several days, the results may be affected if someone were to repeatedly eat a meal with an especially high, or an especially low, resource intensity.

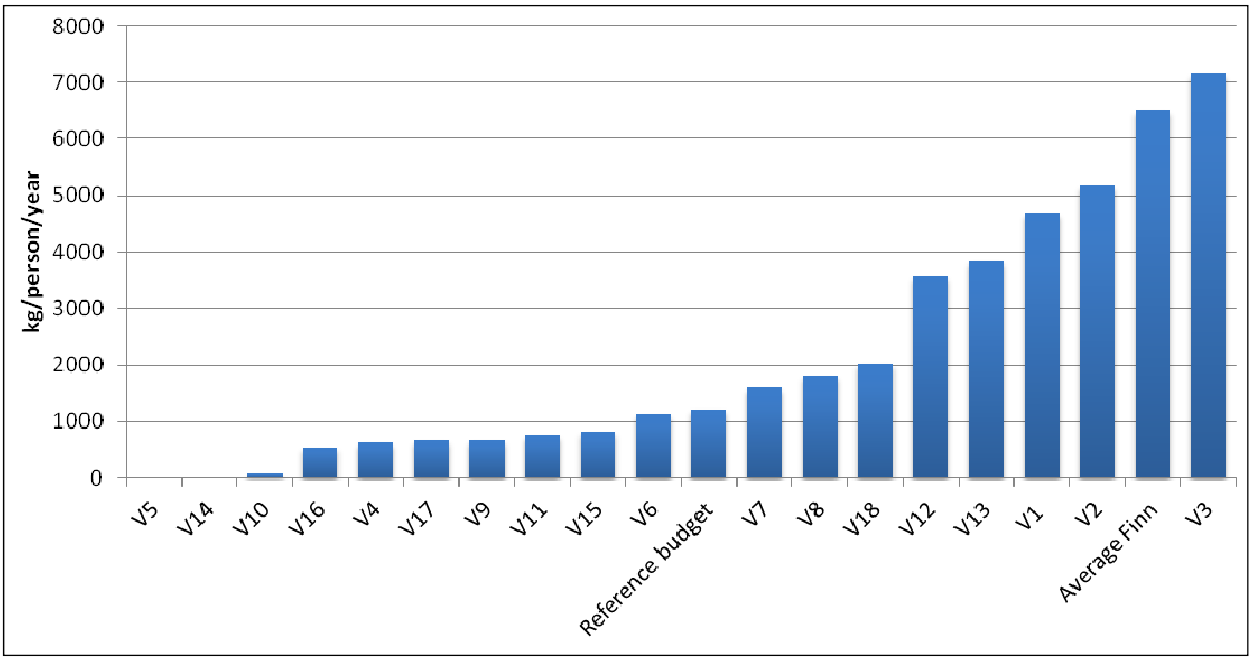
Figure 3. Material footprints for nutrition.



When comparing the material footprints for nutrition to the material footprint of the decent minimum reference budget, we noticed that the results fall within the same range—whereas the average Finn's material footprint for nutrition is slightly higher (6 tonnes). The material footprint for nutrition among the households studied by Kotakorpi *et al.* [2] ranged from 2.6 to 7.7 tonnes, but only four of them were higher than any of the low-income households. Hence, the households studied here appear to use a relatively low amount of natural resources for their nutrition. In reality, the material footprints can be even smaller because, due to the time constraints of this study, we did not take into account how many households ate food that might otherwise have become waste, such as food that was less expensive because of the impending expiration date or donated leftover food from food handouts. We might have assumed that the material footprint of such food was lower than that of other food or even zero because it otherwise would have become waste. With the MIPS concept, the material input of waste or by-products is usually allocated to the main product [10,11].

Third, the material footprints for everyday mobility were relatively low and ranged from zero to seven tonnes per person in a year (see Figure 4). This is due to the fact that none of the households participating in the study owned a car. Many participants did not use any motorized means of transport; therefore, they had a material footprint of zero or close to it. This was possible because most of the unemployed and retired participants did not have to commute to work every day. Only two of them (V3, V15) were working part-time in subsidized employment; they commuted via a private taxi provided by the social program subsidizing their employment. In general, the households lived so close to everyday services that they got along just fine by walking or cycling. Only one participant (V13) used public transportation every day. Some households also used a car: either they borrowed a car (V2) or they used a taxi because of a disability (V1, V3, V12). Those particular households had high material footprints for everyday mobility.

Figure 4. Material footprints for everyday mobility.

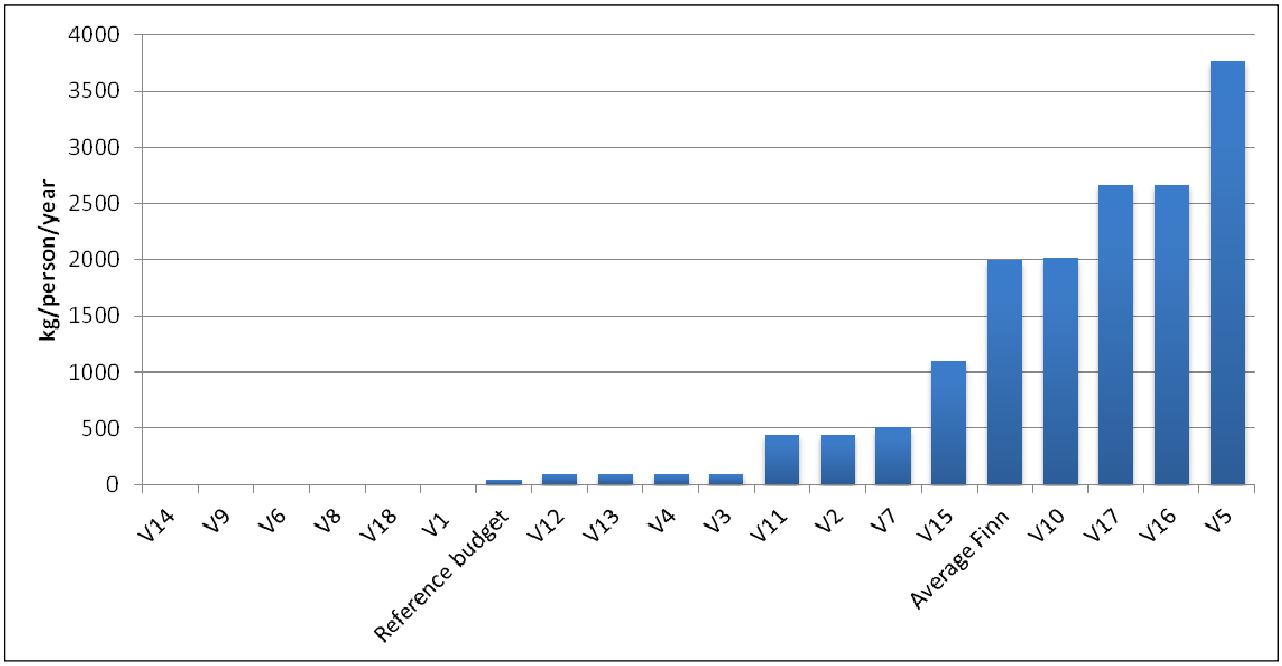


The results correspond to the results from other studies [3]. Half of the participants had material footprints for everyday mobility that were above the level calculated for the decent minimum reference budgets. This is because the budgets assume that single households should only use public transportation and that only a family of four persons should have a car [13]. Only one participant (V3) in this study had a higher material footprint for everyday mobility than that of an average Finn, which was due to his disability and need for a private taxi. The material footprint of the 27 households of varying income levels studied by Kotakorpi *et al.* [2] ranged from 0.6 to 51 tonnes, with 11 of them exceeding the range for the households in this study. This was due to the fact that they used a car as well as to the amount of kilometers that they travelled daily. In general, the slower and less mobile life of the households studied here meant that they consumed fewer natural resources in terms of mobility.

Fourth, the material footprints for leisure-time activities (incl. pets) ranged from 0 to 6.5 tonnes per person in a year, with 17 out of 18 households below 3 tonnes (Figure 5). Most of the leisure-time activities of the participants consumed only a very small amount of resources, like jogging, reading or

doing handicrafts. The greatest resource use belonged to a person (V5) who owned two cats. Several persons (V7, V11, V15, V16) went swimming in public swimming pools regularly and one (V10) went to a gym five days a week. Owning a boat accounted for the third highest material footprint (V17). Concerning the issues of having decent possibilities for social participation, one of the most striking findings is that six households did not report engaging in any activities that had noticeable environmental impacts. Due to their income being insufficient, people mainly stayed at home where they spent their time reading, watching TV or listening to the radio. The energy use of these activities is included in the material footprints for housing.

Figure 5. Material footprints for leisure-time activities.

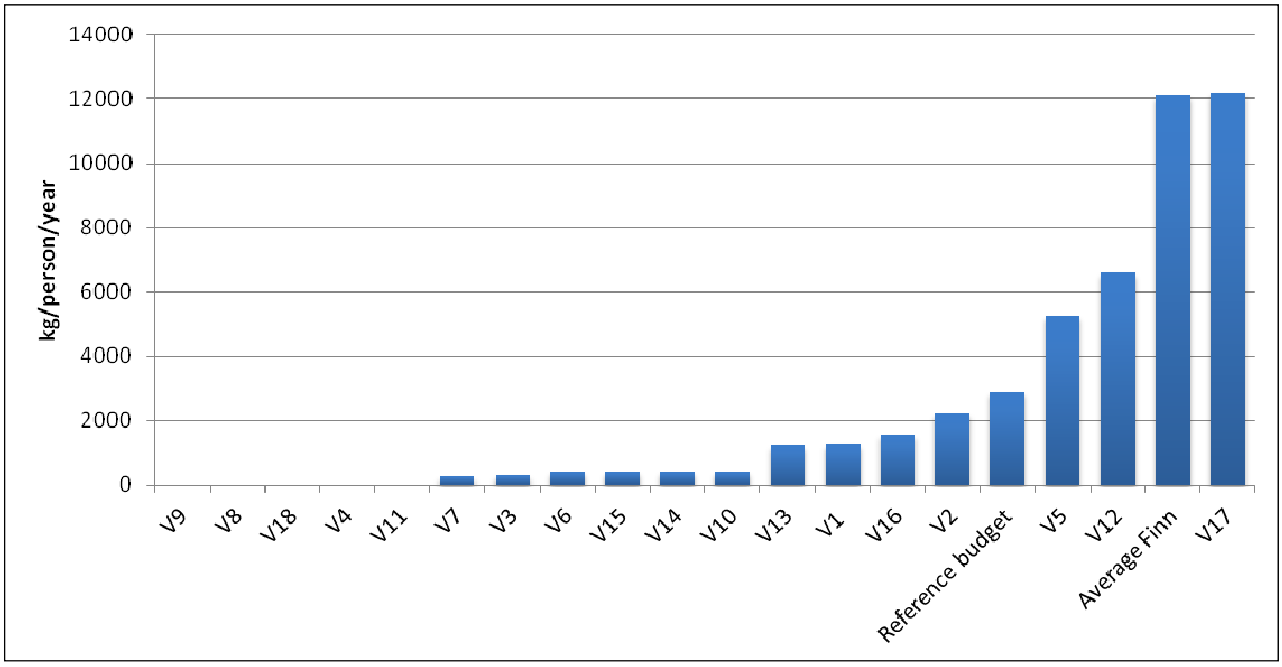


The decent minimum reference budget for single households includes only one leisure-time activity, which explains the small material footprint attributed to this consumption component. Despite the low material footprints, most of the participating households exceeded the level of the decent minimum reference budgets, whereas only three exceeded the level for an average Finn (2 tonnes). The material footprints for leisure-time activities for the households studied by Kotakorpi *et al.* [2] ranged from 0.6 to 16 tonnes per person in a year. Ten of those households had a material footprint of more than 2.8 tonnes for leisure-time activities and none of them had a footprint of zero. Thus, 13 out of the 18 households studied here had a material footprint smaller than any of the households studied by Kotakorpi *et al.* [2], because many of them could only afford to spend their limited means on housing costs and food bills, not on leisure-time activities.

Fifth, the material footprint for tourism (either within Finland or abroad) ranged from zero to twelve tonnes (Figure 6). Only three participants consumed more than 2 tonnes for tourism and five of them had not travelled at all during the previous year—this is basically because households living on a minimum income cannot afford to travel. However, some persons were able to travel, even going abroad a few times a year, because they either had a relative or friend sponsoring their trips or because

they borrowed the money from relatives. The material footprint for tourism also includes the resource use of the summer cottage one participant (V17) had rented at a low price.

Figure 6. Material footprints for tourism.



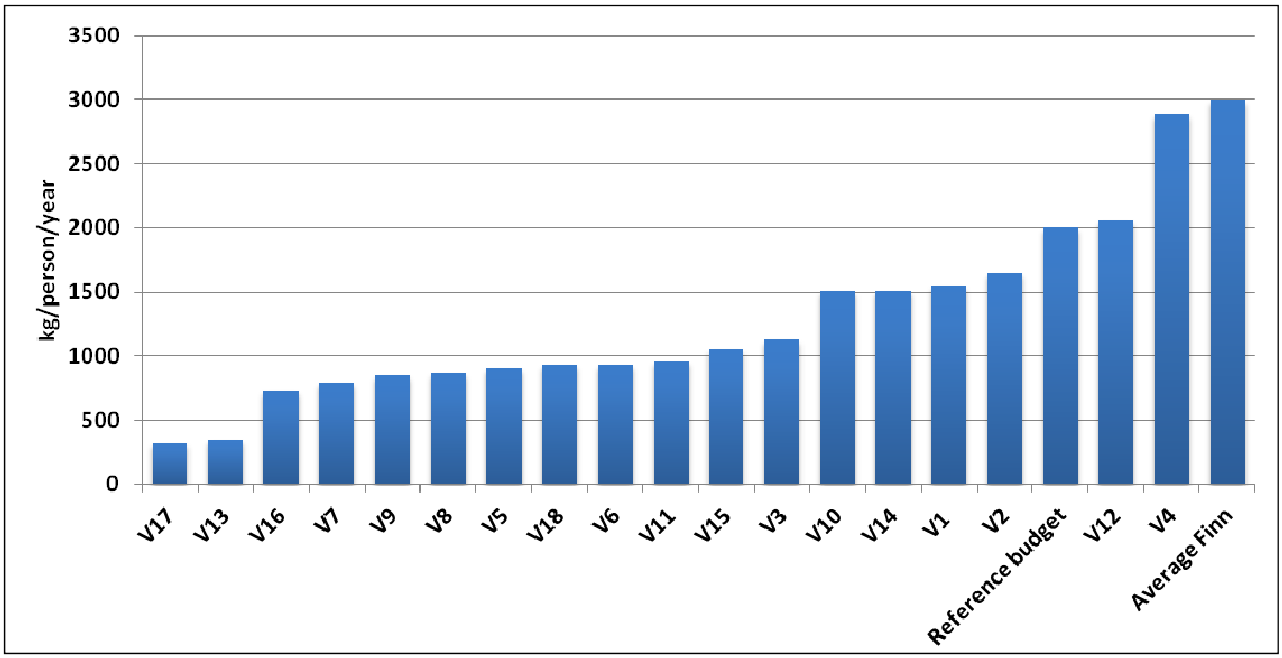
Only three of the households had a higher material footprint for tourism than that of the decent minimum reference budget (see Figure 6). An average Finn's material footprint for tourism (12 tonnes) clearly exceeds the level of all but one of the participants in this study. With material footprints of 1.8 to 42 tonnes per person in a year, the households studied by Kotakorpi *et al.* [2] mostly exceeded the levels found in this study in terms of tourism. In the same way as with everyday mobility, it seems that the standard of living of people living on a low income—and especially on unemployment benefits or disability pensions—requires far fewer natural resources than the travelling-intensive lifestyle of average consumers.

Sixth, the material footprints for household goods were at a maximum of two tonnes per year, except in one case (Figure 7). This includes clothes, all basic furniture, kitchen appliances, electronic devices, and so forth. In comparison to the average consumers, however, the participating households used most goods as long as possible and purchased many of them second hand, including clothes. Both options decrease the material footprint because the estimated use period of the goods is taken into account and because the material footprint of second-hand goods is calculated at zero due to the earlier use of the goods. Only some of the participants managed to regularly buy new items (V4) or else they received new items from relatives (e.g., V12, V2).

We estimated the amount of some of the items, such as clothing and daily household goods, on the basis of the decent minimum reference budgets in order to simplify the questionnaire. Therefore, the displayed values can be considered to be even slightly higher than in reality because the reference budgets take into account more household goods than the households we studied owned. Only one participant had a material footprint for household goods exceeding the decent minimum reference budgets' footprint. None of the households exceeded the level calculated for an average Finn, and only

one household was at more than half that level. The households studied by Kotakorpi *et al.* [2] ranged from 0.6 to 4 tonnes in terms of the material footprint of their household goods. Only five of them were at a level of below 1.5 tonnes; thus, the households in that study stayed within the same level as 16 out of the 18 households studied here.

Figure 7. Material footprints for household goods.



In this study, we took into consideration some of the **services** (like health care and public libraries) that the participants were using, and estimated the material footprint of these services. The results show that these services did not contribute significantly to the material footprint of the participants. The participants fell within the range of 0.2 to 4 tonnes, and only three households had material footprints for services of more than 0.5 tonnes. However, due to time and resource constraints, it was not possible to take into account all of the services that the participants were using. This means that the actual material footprints for services are presumably higher than the ones given here. Among the studies we used as a point of comparison, only the decent minimum reference budgets included the consumption of services like hairdressing or health care (see Table 1).

4.2. Comparing the Material Footprints to a Sustainable Level of Resource Use

Next, we compare the material footprints of the participating households to the ecologically sustainable level of household consumption estimated above (see Section 2). The results show that the households using the most resources in this study did so by a factor approximately 5 times greater than the sustainable level of 6 to 8 tonnes. Half of the participants had a material footprint below 16 tonnes. This means that the households with the lowest levels exceeded the sustainable level by, at most, a factor of 2. Only one household reached an ecologically sustainable level, but that person was homeless when the interviews were performed and, thus, he had not achieved a decent standard of living.

The results indicate that the participating households were closer to the ecologically sustainable level of resource use than both an average Finn, with a material footprint of 30 to 40 tonnes, and the

households studied by Kotakorpi *et al.* [2]. That study of 27 households reported four households with a material footprint of more than 60 tonnes per person per year. For those households, achieving a sustainable level of resource use would require that they reduce their resource use by a factor of 8 or more. Only seven of the households in that study were within or below the level calculated for the decent minimum reference budgets. Interestingly, Kotakorpi *et al.* [2] reported four households with a material footprint of no more than 16 tonnes, and these households also had a relatively low income.

In order to analyze the results, we must take a closer look at the different consumption components, which will help us discuss and operationalize the potential for decreasing the material footprints of households to a sustainable level. For the participating households, housing requires the most resources, which is also the case with the decent minimum reference budgets for single households [13]. Previous studies also indicate that single households and small households have greater environmental impacts and higher energy requirements than other households [3,4]. Since all of the households in this study, except for the homeless participant, had a material footprint for housing that exceeded half the total sustainable resource use level, it seems that the present rate of resource use for housing most probably cannot be maintained in the future. There is a great need for technical innovations to help decrease the resource-intensity of housing. In addition, social innovations that decrease the need for private living space will also be required to help minimize the material footprints of housing.

Most of the material footprints for nutrition account for, at most, half the sustainable level of 6–8 tonnes. In terms of everyday mobility, 13 of the 18 households studied have a material footprint that is within 25% of the sustainable level. In terms of leisure-time activities, only four households significantly exceeded one tonne per person in a year, whereas with tourism four households exceeded two tonnes per person in a year. In terms of household goods, only one household was significantly above 2 tonnes per person in a year. This means that, with the exception of housing, the gap between the material footprints of the participants and a sustainable level of resource use is relatively small. If other households were able to adopt the consumption patterns of the low-income households studied here (e.g., slower mobility, second-hand equipment, low-footprint leisure activities, and so forth.), a sustainable level of resource use might be achievable. However, from a social sustainability point of view, this will be much more challenging than it may seem in terms of mere arithmetic.

When discussing the social sustainability of the participating households, we see that most of the participants did not achieve the socially sustainable standard of living defined in the decent minimum reference budgets: 12 households out of 18 had material footprints below the level of the reference budgets. This supports the findings of previous studies that the minimum Finnish income is not sufficient for a decent standard of living [39]. In general, it seems that in contemporary Finnish society, it might be ambitious to suggest that even the most basic needs for subsistence in terms of adequate nutrition and proper shelter can be satisfied while maintaining a material footprint below the level of 10 tonnes per person, because in this study the lowest material footprint belonged to a homeless person. In addition, the differences in material footprints between the low-income households and an average Finn were remarkably high, especially in the case of leisure-time activities, tourism and household goods. This is naturally related to unequal financial possibilities in terms of consumption and it supports previous research on the connection between income level and environmental impacts (see, e.g., [3]).

As a final point of discussion, it is worth noting that the material footprints of most low-income households studied here were roughly in the same range as the decent minimum reference budgets, especially in the case of nutrition and housing, where the differences between material footprints were generally smaller than in the case of the other consumption components. This indicates that the participating households were able to satisfy their basic needs when it came to food and shelter (except for the homeless participant). None of the participants went hungry, they had warm apartments and, additionally, their standard of living included some recreational activities and even travelling abroad. If comparing to global, absolute poverty, their living standard was certainly decent.

5. Conclusions

The material footprint of the low-income single households ranged from 7 to 35 tonnes per person in a year. Hence, they all consumed fewer natural resources than an average Finn. In most cases, the material footprints were lower than the material footprints calculated for the decent minimum reference budgets [13] and lower than those of many of the households with varying income levels studied by Kotakorpi *et al.* [2]. Regardless, 17 of the 18 participating low-income households were still consuming at least two times more resources than an ecologically sustainable level would allow for in the longer term.

The results represent a standard of living that is both socially and ecologically unsustainable: we found both deprivation and overconsumption. Thus, it can be concluded that the present material footprints do not fall within the necessary environmental limits [9, see also 47]. Accordingly, the conclusion can be made that since even low-income households exceed an ecologically sustainable level of material use in contemporary Finnish society, social sustainability cannot be improved by increasing the amount of natural resources used by low-income households without accumulating ecological destruction. This leads us to ask, what are the implications of the results for future policies and the sustainability debate in general? How could household consumption become more sustainable?

First, measuring the material footprints of households reveals that material footprints, especially for housing and everyday mobility, are highly dependent on infrastructural factors (see also [2,47,48]). However, especially in the case of infrastructure, private households have only limited possibilities to reduce their natural resource use (see also [2,3,15]), and, therefore, a sustainable level of resource use cannot be achieved solely by the choices, decisions and activities of private households. Rather, governments and companies must improve the conditions and technologies that enable households to consume in a more sustainable way. Hence, sustainable consumption should be achieved through changes in the supply of products, services and infrastructure, e.g., in housing and the energy sector (see e.g., [50]).

Second, reducing the level of natural resource use of the participating low-income households would be socially unsustainable in contemporary society. One way of improving the social sustainability of the participating households would be to increase the level of household consumption of people living on minimum income by increasing their social benefits. This would allow them to develop a decent standard of living, and if done, for instance, by increasing taxation, it might decrease the inequality in society. If we were to compensate the increase in the resource use of low-income households by decreasing the resource use of other households, we would at least be closer to a

sustainable situation. As Wilkinson and Pickett [51] have argued, equality in society supports the environmental policy goals of reducing consumption, because there is less pressure to maintain social status by increasing the level of consumption, or trying to catch up the consumption level of richer households. On the other hand, a more generous social policy often requires a growing economy in terms of GDP, and this can be controversial with respect to the targets of reducing the overall use of natural resources. The conclusion could be made that in order to be sustainable, we can no longer afford to alleviate relative poverty in Western welfare states via economic growth (see [52]).

Third, the results lead us to a serious rethinking of the concept of a decent standard of living. On the one hand, the comparison of the material footprints with the reference budgets offers some promising insights. The material footprint calculated for the decent minimum reference budget is approximately half that of an average Finn, which means that the present average material footprint of households in Finland (approx. 40 tonnes per person) could be halved while still retaining the possibility to satisfy basic needs and ensure social participation.

On the other hand, the material footprints would still exceed a sustainable level of natural resource use: even the present decent minimum level is too high for a globally equal and ecologically sustainable future. Although reference budgets are about "fulfilling needs and not wants" [28], in affluent consumer societies like Finland the decent minimum consumption level considers more than just necessities for satisfying basic needs. Essential consumption has become relative, which makes it more challenging to define (e.g., [53]). Delimiting the boundaries of needs and wants is difficult when consumption possibilities tend to increase and new goods, such as different cell phones, enter the market and become "necessities" for socializing and going on many errands. Without questioning the needs for subsistence and affection, for instance, it is obvious that we need different strategies for fulfilling those needs than merely increasing the amount of material possessions [23]. The issue of satisfying needs must be "de-coupled" from material use more efficiently than is the case nowadays.

In this study we have used the decent minimum reference budgets as a measure of social sustainability, but we acknowledge that they are only one possible approach for assessing social sustainability in terms of the adequacy of living standards. Besides this, a socially sustainable standard of living could be understood from a capability perspective as the various "doings and beings" a person is able to achieve, and it could include social possibilities, like the provision of public services (see [24,27]). In addition, a decent standard of living could be understood more universally. The estimates for an ecologically sustainable level of natural resource use take into account the needs of the entire global population and future generations. We suggest that "decency" should also be assessed more universally, for instance based on the universal basic needs defined by Doyal and Gough [54], or by setting a minimum threshold for basic capabilities, as Nussbaum [55] has proposed. The concept of a more universal and ecologically sustainable decent standard of living would be worth further research.

Conflict of Interest

The authors declare no conflict of interest.

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