Chapter 1 Natural resource consumption of tourism

Case study on free time residences and hotel accommodation in Finland

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1 Introduction

Tourism is one of the major factors in household consumption. It has also arguably become the most rapidly growing area of consumption in the last few years. In 2006, 842 million international tourists were recorded worldwide. Compared to the previous year this represented an increase of 4.9 per cent (UNWTO World Tourism Barometer, 2007). In addition to international tourism domestic tourism is also a major phenomenon. According to Official Statistics of Finland (2007), 25 million domestic overnight, and 3.1 international overnight, leisure trips were made by Finns in 2006. In the case of domestic trips there was a slight decrease compared to 2005 (3 %) and international overnight trips increased by 1 per cent. In general the trend of both types of travel has been upward during recent years. According to the European Environmental Agency (2005), tourism is increasing and especially air travel is growing as cheap flights contribute to the attractiveness of flying.

The continuing increase in tourism stresses the need to study environmental pressure caused by the tourism sector. This paper focuses on the natural resource consumption of domestic tourism by Finnish households and special attention is paid to accommodation. Some examples of the resource consumption of trips with both accommodation and transport included are also provided in chapter 4. Resource consumption and efficiency is measured using MIPS (Material Input per Service unit). The eco-efficiency of tourism has been previously studied using a variety of methods (e.g. Gössling et. al., 2005; Gössling et. al., 2005; Hunter and Shaw, 2007; Peeters and Schouten, 2006) but not with MIPS. The FIN-MIPS Transport study (Lähteenoja et. al. 2006) provides extensive information on the essential component of tourism, passenger transport. Data used in this paper was collected in the FIN-MIPS Household research project (Lähteenoja et. al., 2007), in which five sectors of household consumption were studied.

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Statistics were consulted first to find out where and how Finns travel for holiday purposes. It was shown that excluding visiting friends and relatives trips (VFR) the most common leisure trips among Finnish people are trips to private free time residences and domestic trips with paid accommodation. These trips contributed over 68 per cent of the total number of leisure trips made by Finnish people in 2005, if VFR trips are excluded. The rest of the trips are overnight trips abroad or cruise trips (Official Statistics of Finland, 2006a).

2 Definition of concepts, MIPS method and data collection

2.1 Definition of concepts

Essential concepts of this paper include tourism, free time residence, MIPS and natural resource consumption. The last two will be explained in the next chapter; here attention is paid to the concepts of tourism and free time residence.

The concept of tourism in this paper is based on the definition by the World Tourism Organization. According to UNWTO (1994) tourism comprises the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes. This paper focuses only on leisure travel. Moreover, only domestic travel is considered. Furthermore, the UNWTO definition would consider frequent (i.e. every weekend) visits to free time residences not to count as tourism as the residence would be part of the person's "usual environment". Even so, within this context all overnight trips to free time residences would still be considered tourism but day trips are excluded.

Various concepts i.e. second or vacation home, are used to define a place to stay at in addition to the first, permanent home (Aho and Ilola, 2006; Hall and Müller, 2004). In line with the concept used by Statistics Finland, free time residence was chosen to define the place where Finns spend a lot of their free time. In spoken Finnish *kesämökki* (summer cottage) is commonly used but as free time residences nowadays are being increasingly used all year round and the facilities in many recently built cases are almost equal to those in permanent residences, the "summer" cottage is not seen to satisfy the characteristics of free time residences very well. In this paper free time residence is defined as a one-family house. It must, however, be kept in mind that, for example, at Finnish skiing resorts, apartments in housing complexes are a common form of second homes (Kauppila, 2007).

2.2 MIPS as a calculation method

The MIPS (material input per service unit) indicator is a tool for measuring natural resource consumption. The indicator helps to define the material input (MI) of a specific product or service (S). This makes it possible to measure the benefits against the life-cycle-wide resource consumption. The method can be used as a tool to compare different products according to their resource efficiency. MIPS also reveals what the consumption comprises and helps to reduce the consumption where it is most significant. (Ritthoff et. al., 2002; Schmidt-Bleek, 1993).

In MIPS analysis natural resource consumption is calculated in six categories, viz. abiotic and biotic resources, erosion, earth movements in agri- and silviculture, water and air. Earth movements and erosion are not considered in this study as they are noteworthy only in the case of agricultural products, i.e. cotton in this case. MIPS is one tool for measuring resource efficiency. As the amount of resources used per service unit decreases the resource efficiency of a particular product or service increases.

In this study the service unit of accommodation is defined as natural resource consumption (in kilograms) per person per night. It is assumed that in free time residences two people overnight at the same time. In Finland the average size of a household owning a free time residence is 2.1 persons (Official Statistics of Finland, 2005a). The total number of overnights in the two case hotels in 2006 was used to calculate consumption per person per night. In the case of free time residences a study by Nieminen (2004) was used to define the average occupancy rate of private free time residences. According to a study by Nieminen (2004), the average occupancy rate is 72 days per year. This includes the days when the residence is occupied by members of the owner family. Only days when the stay was over 12 hours long were included for the occupancy rate.

2.3 Data used in this study

To define the scope of the calculations, two hypothetical cases of free time residences were formed using the information provided by the statistics, studies and documents related to a recent case of the building of a free time residence by one of the authors. The first case is small and simple with only a few facilities. According to the statistics and previous studies it represents the traditional and most common type of free time residence in Finland. In 2004, the floor area in 37.4 per cent of the residences was 20–39 m² (Official Statistics of Finland, 2005a).

The second case represents the rising trend towards the new free time residence building. According to statistics, the proportion of larger residences has increased from 1970 to 2004 (share of residences with a minimum floor area of 40 m² increased from 38.3 % to 48.3 %) and electricity consumption was 20 times higher in 2004 compared to 1970 (Official Statistics of Finland, 2005a; Official Statistics of Finland, 2005b). Many of these new residences are almost identical to permanent single-family houses. Energy consumption and the facilities available in both types were defined with the help of statistics and studies in order to obtain more reliable results than when only data on the case residence was used. (Official Statistics of Finland, 2005a; Official Statistics of Finland, 2005b; Nieminen, 2004; Melasniemi-Uutela, 2004; Pitkänen and Kokki, 2005; Sevola et. al., 2003). Calculations of the material consumption of the building and earthworks were based on documents appertaining to a free time residence building constructed in 2005. This building represents the average, simple type of wooden residence well. Calculations on the well equipped type are also based on a simple case. The floor area was increased and the facilities improved.

In co-operation with two hotels, case studies of the natural resource consumption of hotel accommodation were undertaken. Both the hotels, the Radisson SAS Seaside in Helsinki and the Sokos hotelli Arina in Oulu, are city hotels.

Both in the case of free time residences and hotels, in addition to basic calculations sensitivity analyses were also performed. This means that the results were tested so that one variable at a time, i.e. occupation rate, was modified to see how different factors changed the total resource consumption per overnight occupancy.

Figures on the natural resource consumption of passenger transport were provided by the research project Transport MIPS (Lähteenoja et. al., 2006) and this data was used in the analysis of the natural resource consumption of leisure trips in chapter 4.

2.3.1 System boundaries

The principle for setting the boundaries for calculations was to define what is needed in a residence or hotel so that it can provide accommodation. Secondly, the availability and importance of different variables were considered. Figure 1 shows the system boundaries. The broken line and broken outlines of boxes represent the variables excluded from the analysis.

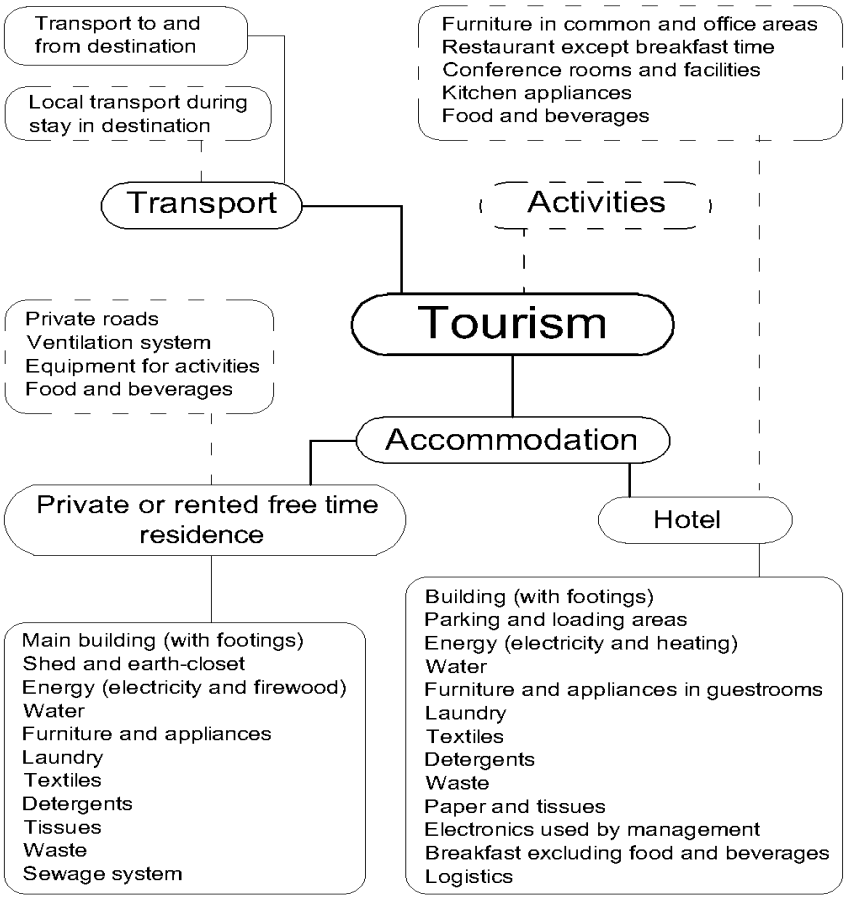


Figure 1. System boundaries for the study

2.4 Free time residences

There were almost half a million free time residences in Finland in 2004 (Official Statistics of Finland, 2005a) and every second Finn spends time in a free time residence every year. Free time residences provide many services. In this study accommodation is the key perspective and the service unit for the calculations is resource consumption of the residence and associated buildings per night total and per person per night. A description of the cases will be provided next.

A simple type of free time residence is a wooden building with a floor area of 29 m². The building has one and a half floors, as sleeping facilities are located in a loft. Electricity consumption is approximately 1,550 kWh per year, firewood consumption 1.8 m³ per year (measured in solid wood) and drinking water consumption is 5 litres per person per day, with water being brought from the permanent residence. The factors included are listed in figure 1. The material input of building materials also includes transportation and earthworks. Materials required for periodical repair work are included, as well as kitchen appliances and furniture. The toilet is an earth-closet in a separate building.

The floor area of the well equipped free time residence is 90 m² and the building is on one level. Electricity consumption is approximately 9,000 kWh per year and firewood consumption the same as in the simple residence, 1.8 m³. Tap water consumption is 155 litres per person per day spent in the residence as the residence is served by a municipal or other water supply system. In this case a water-closet, washing machines and dishwasher are available. The water treatment system is therefore more advanced than in the simple case. The range of electronic machines and appliances is wider than in the simple type of residence.

Private roads are often needed for access to free time residences in Finland. However, data on the average amount of kilometres of private road per residence was not available. This means that the number of road users and types of roads serving free time residences are also unknown. For these reasons private roads had to be excluded from the study. However, material consumption related to private roads can be very high, especially due to the low rate of use. Some suggestions were still made in chapter 3 about how resource consumption would change if private roads were to be included. Data used for calculations regarding the roads were based on figures relating to private roads serving permanent residences in Finland (Talja et al., 2006).

As free time residences are also available for rent and the average occupancy rate of these residences is higher compared to private ones, calculations were also made to see how a higher rate of occupancy affects the resource consumption. Average occupancy rates vary according to the facilities and size of the rented residence. For a simple type of residence the occupancy rate would be 14 weeks (98 days) a year and for a well equipped one 20 weeks (140 days) a year. Average figures were provided by Lomarengas which is the largest company renting privately owned free time residences in Finland (Purhonen, 2006).

2.5 Hotels

System boundaries for hotel calculations are shown in figure 1. With the resources available it was not possible to make calculations from the primary construction data as was done with the free time residences. Existing data on

the resource consumption of public buildings was used in the estimations of the resource consumption of the hotel buildings, earthworks and parking facilities (Sinivuori and Saari, 2005; Nieminen et. al., 2005). The floor area of the hotel buildings was used to calculate the resource consumption of the building. The floor area, room height, and the size of parking and loading areas built below ground level were used to estimate the extent of the earthworks.

Total natural resource consumption is given per overnight stay. Allocations were made so that the space and consumption of restaurants and conference facilities were excluded from the calculations, apart from restaurant use for breakfast, which is included in the price of the stay. However, all food and beverages were excluded from the study. Hotel specific occupancy rates for 2006 were used to calculate the figures per overnight stay. When occupancy rates of the cases given are compared to the average Finnish occupancy rate of hotels it should be noted that the cases put forward here have higher than average occupancy rates. The average bed occupancy rate was 38 per cent in 2005 (Official statistics of Finland, 2006b). Bed occupancy rates at Radisson SAS Seaside and Sokos hotelli Arina were 48 and 52 per cent respectively in 2006.

3 Natural resource consumption of accommodation on leisure trips

3.1 Results, free time residences

The two tables below show the natural resource consumption of the free time residences studied. Consumption has been calculated for the whole life span of the residence (75 years), per year, per day in use (72 days per year) and per day per person. It is assumed that two persons are using the residence simultaneously and the total consumption is therefore divided by two in the calculations for one person. The total waste production and amount of laundry, etc., is estimated for two people. If the electricity and heat consumption are considered not to be dependent on the number of people using the residence, only 2 per cent of the abiotic resource use was dependent on the number of people using the residence.

Table 1. Natural resource consumption of a simple and a well equipped free time residence

Type of residence and time scale	**Material input (MI) kg**			
	Abiotic	**Biotic**	**Water**	**Air**
Simple, MI kg per life span (75 years)	325,000	225,000	30,741,000	145,200
Simple, MI kg per year	4,300	3,000	409,900	1,900
Simple, MI kg per day in use	60	42	5,700	27
Simple, MI kg per day in use per pers.	30	21	2,850	14
Well equipped, MI kg per life span (75 years)	1,019,100	320,300	146,533,000	286,800
Well equipped, MI kg per year	13,600	4,300	1,953,800	3,800
Well equipped, MI kg per day in use	189	59	27,140	53
Well equipped, MI kg per day in use per pers.	95	30	13,570	27

In the abiotic category approximately 65 per cent of the simple residence resource use was attributable to buildings and related earthworks. In the well equipped case the share was approximately 56 per cent. Electricity is significant in all categories except biotic resources. In the case of Finland the share of hydropower in energy production affects the water consumption related to the use of electricity. The water consumption of hydro power is included in the MI figures of electricity as water bodies are regulated and this affects the natural hydrological cycle. Biotic resource use is mainly due to building materials and fire wood consumption. In the simple case fire wood is the biggest factor in air consumption as the oxygen consumed in the burning process is included in the calculations. In the case of the well equipped residence electricity has a larger share in the air category than fire wood as the amount of electricity consumed is almost six times greater than in the simple one. (Salo et al., 2008)

When these two cases are compared the difference is considerable. Abiotic resource consumption is more than tripled in the well equipped case compared to the simple one.

Table 2: Percentual change in resource consumption according to sensitivity analyses of free time residences

Type of residence	**Sensitivity analysis**	**Effect on MI figure (per year) +/- %**			
		Abiotic	**Biotic**	**Water**	**Air**
Simple	Average electricity → wind power	-16	0	-72	-18
Well equipped	Average electricity → wind power	-30	0	-87	-52
Simple	Electricity consumption -70 %	-13	0	-50	-12
Well equipped	Electricity consumption -70 %	-25	0	-61	-36
Simple	Private road 0 m → 300 m	+755	0	+176	+15
Well equipped	Private road 0 m → 300 m	+241	0	+37	+8
Simple	Occupancy rate 72 → 98 days/year	+1	0	+1	0
Well equipped	Occupancy rate 72 → 140 days/year	+7	0	+15	+9
		Effect on MIPS figure (per day occupied) +/- %			
Simple	Occupancy rate 72 → 98 days/year	-26	-27	-26	-26
Well equipped	Occupancy rate 72 → 140 days/year	-45	-49	-41	-44

Table 2 shows the percentual difference between basic figures and modified calculations. In the basic calculations MI values for electricity consumption were based on the average composition of national electricity production. The MI-factor for average electricity in Finland was calculated

by Nieminen (2005). In the sensitivity analysis electricity was one variable which was modified. Instead of average electricity it was assumed that the electricity consumed was produced with wind power. The decrease of consumption in the case of wind power (in percentages) is greatest in the water category because the water consumption of hydropower is eliminated. The consumption of abiotic resources and air also decreased tremendously.

In addition to the production method of electricity the amount of electricity consumed was also considered. The 70 per cent reduction suggested here is quite dramatic. This would require practically giving up almost all heating with electricity. In general, as electricity consumption in free time residences has been growing it has had a marked impact on the amount of their resource consumption during recent decades.

Adding 300 metres of private road to the calculations caused a tremendous increase in particular in the abiotic resource consumption. This is due to the great amount of soil and rock material extracted and brought in for the road construction. The figures used in this calculation were based on private gravel roads serving permanent residences. This road type might be more massive than is needed for a free time residence. At least this analysis gives an idea of how relevant an impact the road infrastructure might have on the total resource consumption.

Raising the occupancy rate naturally increases the total resource consumption of a residence. However, the increase is small compared to the decrease in consumption figures per day in use. The higher yearly increase of occupancy in the case of a well equipped residence is due to the increased amount of electricity consumed, as this residence is assumed to rely more on the electric heating than the simple one. Occupancy rates used in the sensitivity analyses were the approximate figures for rented residences. This suggests that the use of rented residences is more efficient than that of private ones. Due to the absence of data, in this study the occupancy of friends and relatives was not included in the private residence occupancy rate. The assumption is that friends and relatives usually visit free time residences at the same time with owners of the residence. Even so, this should be considered when private and rented cases are compared. There was no additional consumption of biotic resources as the amount of firewood consumed was considered constant.

According to the basic calculations and sensitivity analyses, natural resource consumption of the use of free time residences per person per night varies between 22–321 kg of abiotic resources, 15–30 kg of biotic resources, 808–18,570 kg of water, and 10–29 kg of air. The results of the analysis and the means of decreasing resource consumption, or keeping the consumption low, are further discussed in chapter 5.

3.2 Results, hotels

The results of basic analysis will be presented next. It should be kept in mind that the geographical location of hotels varies and this causes differences in heat consumption. Two cases are not presented here for the purpose of relative comparison but to provide two cases reflecting the amount and consistence of the natural resource consumption of hotel accommodation.

Table 3: Natural resource consumption of hotels

Hotel and time scale	**Material input (MI) kg**			
	Abiotic	**Biotic**	**Water**	**Air**
Radisson SAS Seaside, MI kg per year	4,416,300	18,600	537,985,900	1,680,400
Radisson SAS Seaside, MI kg per overnight	37	0	4,510	14
Sokos hotelli Arina, MI kg per year	4,446,600	15,650	337,455,000	1,757,100
Sokos hotelli Arina, MI kg per overnight	45	0	3,400	18

In table 3 figures for material consumption are given per year and per overnight. When abiotic resource consumption is considered, the major three components of consumption are buildings, electricity and heating. In the biotic category building and furniture are the most significant factors. Whatever the case, the amount of biotic consumption per overnight stay is approximately 0.2 kg. As in the case of free time residences, electricity consumption in hotels attains the highest peak in the water category. Electricity and heating are the largest single factors of air consumption.

Table 4: Percentual change in resource consumption according of sensitivity analysis related to hotels

Hotel	**Sensitivity analysis**	**Effect on MI figure (per year) +/- %**			
		Abiotic	**Biotic**	**Water**	**Air**
Radisson	Electricity -20 %, heat -20 %	-10	0	-16	-16
Arina	Electricity -20 %, heat -20 %	-10	0	-14	-17
Radisson	Average electricity → wind power	-24	0	-80	-30
Arina	Average electricity → wind power	-13	0	-69	-15
Arina	Restaurants included	+32	+12	+106	+30
Radisson	Overnights +20 %	+3	0	+2	+10
Arina	Overnights +20 %	+4	0	+5	+5
Compact hotel	Compared to Arina	+12	+24	+15	+16
		Effect on MIPS figure (per overnight) +/- %			
Radisson	Overnights +20 %	-14	-17	-15	-8
Arina	Overnights +20 %	-13	-16	-12	-12
Compact hotel	Compared to Arina	-26	-18	-24	-23

It was noted that electricity and heating account for a significant part of the resources consumed in hotels. In the first sensitivity analysis the effect of a 20 per cent decrease in both electricity and district heating consumption was analysed. The results in the Radisson and the Arina in relation to this analysis are rather similar. Reductions appeared to be highest in the categories of air and water but were also considerable in relation to abiotic resources. When wind power is considered instead of average electricity, the

reduction in the Radisson is higher compared to the Arina, as the contribution of electricity towards the total consumption of resources is greater. When the total resource consumption of restaurants was included in the Arina calculations consumption in the water category doubled, while increases in the other resource categories are also considerable. In particular the electricity consumption is responsible for this increase. It should be noted that the Arina has several restaurants and that services are provided almost 24 hours per day. This aptly demonstrates the complexity of allocating the restaurant service between overnight guests and other customers.

As was noted in the case of free time residences, the number of overnights increases the total consumption, but even so consumption per overnight decreases. Higher occupancy rates lead to a more resource efficient service if values per overnight are considered.

A hypothetical calculation was made to estimate how room size affects the natural resource consumption per overnight in hotels. The Arina was used as a basic unit for comparison. In hypothetical calculations of the "compact hotel" room size was decreased compared to the basic calculations. A compact room size of 15 m² was used and 394 rooms could be provided in the Arina instead of the 260 rooms provided at the moment. The bed occupancy rate was kept constant so that the total number of overnights is higher in the compact case. As electricity use, heating, water and the number of items in rooms increased with a higher number of rooms and overnights, the total consumption of natural resources naturally increases, but again resource consumption per overnight decreases as the basic infrastructure is shared with more service units. The results of these calculations are included in tables 5 and 6.

According to the basic and sensitivity analyses the natural resource consumption of hotel overnight per person varied in the abiotic category between 28–59 kg, between 888–7,000 kg in the case of water and between 10–23 kg in relation to air, respectively. Biotic resource consumption was almost zero in every case.

4 Natural resource consumption of travel and accommodation on leisure trips

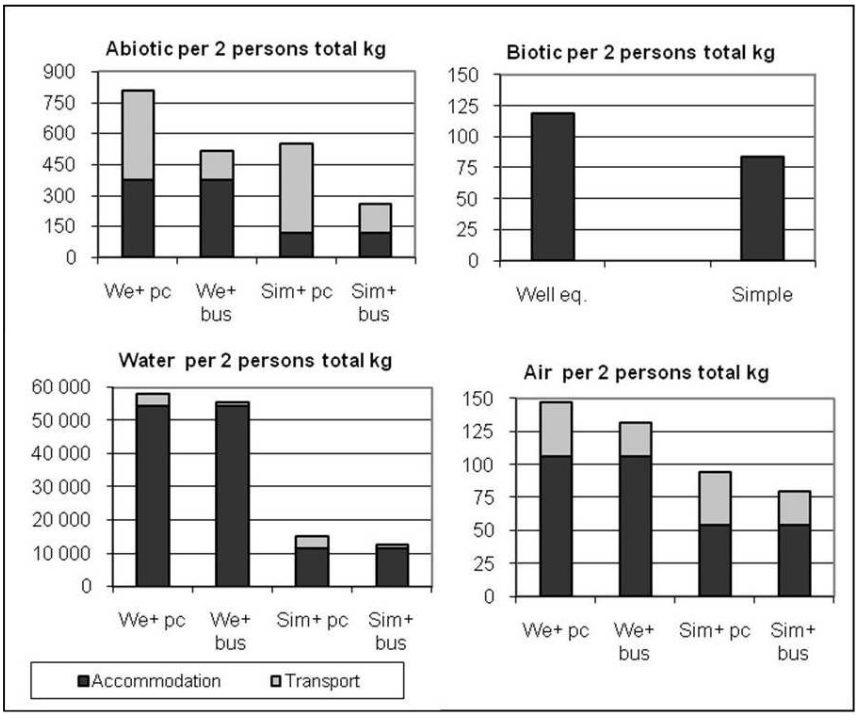
So far in this paper the focus has been on accommodation only. Tourism would not exist without mobility as this is already by definition part of tourism activity. According to previous studies mentioned in the introductory chapter (see Gössling et. al., 2005; Gössling et. al., 2005; Hunter and Shaw, 2007; Peeters and Schouten, 2006) transport has a major role to play in environmental pressure caused by tourism.

Studies also show that personal mobility is increasing and this stresses the importance of examining passenger transport, too. According to the National Transportation Study (2007), passenger traffic is increasing in Finland. Seventy-one per cent of trips of over 100 km were related to leisure time and private car was the most common means of transport. In particular transportation to free time residences seems to depend on the private car, as according to studies, around 95 per cent of trips were made at least partly by passenger car. Approximately 4.7 billion passenger kilometres are annually related to travel to private free time residences. This figure also includes day

trips. For domestic leisure travel with paid accommodation (at least one overnight) the private car is the most common means of travel, covering 79 per cent of the trips. (NTS, 2007; Pitkänen and Kokki, 2005; Ministry of Transport and Communications, 1999).

Here a few examples are given to show the total natural resource consumption of two types of weekend trips and the share of accommodation and passenger transport in the total resource consumption of the entire trips. The figures are calculated as the total consumption for two persons.

The first case concerns a trip to a private free time residence. Both simple and well equipped types are included, as well as two modes of transportation, i.e. private car and bus. According to Nieminen (2004), the length of the average return trip to a free time residence is 214 km is also used in this study. In figure 2 the variation between residence types and transport modes is shown. If a private car is used, transport makes a higher contribution to abiotic consumption than accommodation. The reason for this is the vast abiotic resource consumption of the transport infrastructure which is included in the MI figures for transportation. The transport contribution to air consumption is also high and in the case of simple residence and private car transport almost doubles the air consumption compared to bus transport. MI figures for transport do not include biotic consumption (i.e. trees cut at the time of road construction). The biotic consumption shown below only includes the consumption related to accommodation. Figure 2 also clearly shows the difference between the two types of residences, as already discussed in chapter 3.1.



Note: We= Well equipped residence, Sim=Simple residence, pc=private car

Figure 2: Natural resource consumption of a weekend trip to free time residence

The second case given here concerns another type of weekend trip, a short stay in a hotel. The data on accommodation comes from the Arina, as the most extensive data was provided by this particular hotel. The objective was to calculate transport using three different options. A return trip from Jyväskylä to Helsinki was used here as an example. The length of the return trip by road is estimated to be 543 km. Figure 3 shows the vast differences transport makes to the total consumption. Again, the private car is responsible for the peak in the abiotic category. The biotic category is not included here as the total consumption would be less than one kg. If a trip is made by plane, water and air consumption in particular are multiplied compared to other transport options. Water consumption is vast, partly due to the rain water drained from the airport. In the case of small airports with only a few operations the contribution of one flight towards the total consumption of water is high. As the flight is short the fuel consumption is higher per flight kilometre compared to longer flights. This contributes to the high air consumption of the trip.

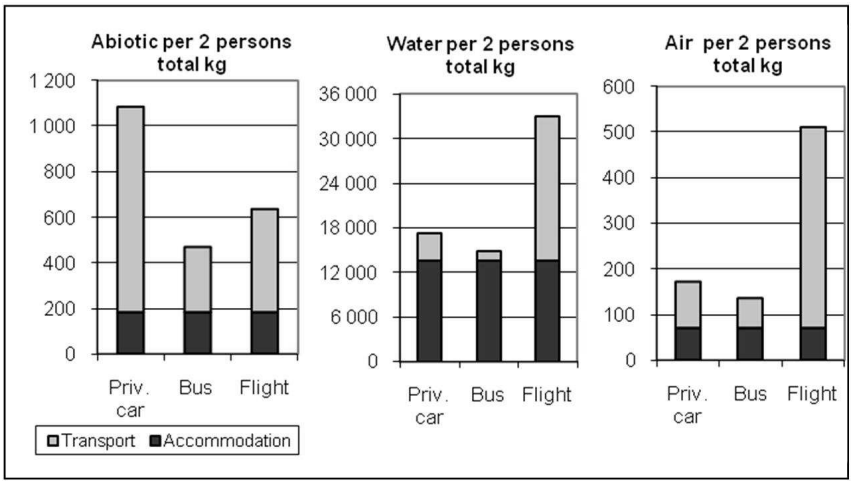


Figure 3: Natural resource consumption of a weekend trip to hotel with three transport options

If figures 2 and 3 are compared and the resource consumption of accommodation only is taken into account, the well equipped residence seems to consume more resources in every category compared to other options. The simple residence consumes the least in every category except biotic resources. The total consumption of a particular trip still largely depends on the transport related decisions. According to the cases discussed here, transport, especially in the abiotic and air categories, accounts for a vast proportion of the total consumption even if the distances travelled in these examples are not extensive. The proportions would be totally different, if figures for a longer stay were to be calculated, naturally depending on the distance travelled and the mode of transport used. If the number of days spent on leisure travel is considered constant, how a person decides to allocate this travel budget is important. The statistics indicate, and the rhythm of working life supports the fact, that in numerical terms most trips are one or two day trips. In these cases transport is the factor making the difference as its consumption is repeated in the case of every trip.

5 Reducing material intensity of tourism

5.1 Transport

As figures 2 and 3 show, transport choices have a huge potential to affect the total material intensity of travel. Another issue is whether public transport really is an option on all types of leisure travel and why is this so. In the case of free time residences public transport might not always be available except for residences located in holiday resort areas. A peripheral location is also linked to a low level of use of road infrastructure. In these cases the material input per passenger kilometre is much higher than average. To reduce the material intensity of travel to free time residences the location of a residence should be chosen so that public transport is available and used, the distance is short, and the length of a stay would be extended instead of raising the number of separate trips.

In the case of hotels the same rules apply. Hotels located in cities or holiday resorts are usually served well by public transportation. Tourists can especially influence the resource consumption of a holiday trip when making the transport decision, as the framework of consumption at the hotel is set by the service provider.

5.2 Energy

According to the cases discussed in this paper, electricity and heat are the major consuming factors in addition to the built infrastructure. Efficiency in energy issues may constantly be developed and this makes it very much a potential issue in the discussion of efficiency. The efficient use of energy is a responsibility of both guests and service providers. There are techniques to prevent wastage of energy and these should be made use of by hotels. For guests the best way to avoid excessive consumption is to keep an eye on the use of warm water, heating, air conditioning and lighting.

Households have more power in energy issues relating to private free time residences: what kind of heating system is used, what is the energy source, and how much electricity is consumed. Larger residences require more heating and more space is available to fit in electrical appliances. In well equipped residences heating is in many cases required or recommended during the winter time even if the residence is not used, as the water system and appliances might otherwise be damaged. Attention should be paid to this issue in relation to providing solutions for constructing systems so that no heat, or as little as possible, is needed during the winter time when the residence is not in use. When fire wood is used, attention should be paid to the quality of the fuel and burning conditions to maximize the heat gained and also to minimize harmful emissions.

5.3 Buildings

Footings, earthworks and space built below ground level define most of the abiotic resource consumption of buildings, especially in the case of small ones. This is due to the vast amounts of soil and rocks moved from their original place. Thus, in the planning phase the location and specific needs should be considered so that no excessive earthworks are needed. One option is to use recycled material, i.e. waste land or construction waste, to reduce the need for new material. In the case of both small and larger buildings

adding floors reduces the material load per square metre of floor space in use. Wood is a light construction material which reduces the material intensity of the building and also means that lighter footings may be built. Tamminen et. al. (2007) have studied the material consumption of housing and provide more detailed analysis on the topic.

In the case of both free time residences (simple vs. well equipped) and hotels, a smaller room or residence size per visitor means a more efficient service. The size and type of the building affects the material input during the building phase, but throughout the whole life span size will also determine to a large extent the need for heating. Space also allows increases in the amount of furniture and appliances and a larger number of electrical appliances in particular will further increase the total material consumption.

5.4 Occupancy rate

An increase in occupancy always increases the material consumption. However, if an increase in occupancy rate with the existing infrastructure will decrease the pressure to build new accommodation, any increase in existing occupancy will be resource efficient. According to this paper, an increase in the occupancy rate may decrease material input per overnight significantly. If the increase in occupancy is caused by an extension of the length of stay it is most efficient, as no extra transportation is needed.

If a rise in the occupancy rate of private free time residences would decrease the use of other accommodation infrastructure, this can be considered to be resource efficient from the accommodation point of view. However, as we saw in chapter 4 transport plays a major role and this needs to be remembered, too. Non-family visitors in private residences were not taken into account in this study but visitors also increase the occupancy rate. It is more efficient to share one residence instead of having several residences. According to information from Lomarengas, an average length of stay in a rented residence is longer compared to private ones. Taking into account also the fact that overall occupancy rate is higher in rented ones this makes the use of these in general terms more resource efficient than private ones, if accommodation only is considered.

5.5 Government control and guidance

As tourism is not a necessity, the demand for the activity depends on various factors and not the least on the state of household, national and international economics and the (international) political atmosphere. Economics also provide a means to influence the resource efficiency of tourism. Transport is the essential tourism activity. As discussed in this paper, the mode of transportation highly affects the total consumption. The question should be raised whether the current pricing policy of fuels and transport services encourage tourists to make resource efficient choices. The question of energy is also related to accommodation: what is built, how, and what kind of energy is used.

Local and national level planning policy sets the framework regarding at which locations new infrastructure is built. Especially in the case of free time residences more densely and spatially concentrated planning would increase resource efficiency, as this would raise the efficiency of the use of the infrastructure and help to provide public transportation and other services.

5.6 Free time residences, a Finnish institution

Free time residence is one of the essential institutions of the Finnish culture. Many people have access to their own free time residence or one belonging to a relative. Spending time in a free time residence is considered to be linked to the notion of respect for, and being close to, nature. This is the reason why most people prefer, if possible, to build their free time residence in a peripheral and isolated place. When a holiday is spend in the heart of a natural environment it is easy to forget about the environmental pressure caused by the activity. Again, mental images of free time residences are still based on simple living, even if the standard of living is nowadays in many cases close to that in permanent residences.

Here suggestions have been made regarding how the material intensity of free time residences could be decreased. The passenger transport and infrastructure needed for transport is one of the major issues. As long as a peripheral location forms an essential part of the institution of free time residence use, suggestions for denser planning seem difficult to realise as this would question the whole idea that many people have about free time residences.

A free time residence is not only a place to which to stay overnight. This is the reason why a hotel, or even rented free time residences, are not always substitutes for a free time residence owned by oneself or the family. Many activities are not possible anywhere else than in one's own free time residence. The property itself might also be meaningful, if it has been owned by the family for several generations.

These are the reasons why in the case of private free time residences there is a huge challenge to develop the culture towards a less resource consuming future. The first step is to make people aware of the real state of the resource consumption of the activity and then begin to think what kind of a less consuming free time residence culture could be acceptable, or whether it is possible to reduce resource consumption (on a personal and household level) elsewhere, if the free time residence is considered to be an essential part of personal consumption.

6 Overall conclusion

Households have individual monetary and time budgets allocated for leisure travel. If this budget is to be used in a resource efficient way, careful attention should be paid to the frequency, geographical distance and length of stay. Government policies set the framework in which tourists and service providers operate. In this framework both stakeholders may or may not seek to apply resource efficient practices while engaged in their activity. Energy is a major issue to focus on when it applies to transport and consumption related to accommodation. Material inputs and the efficient use of infrastructure for transport and accommodation are other key issues.

As biofuels increase their share of the markets, research is needed on how this will change the resource consumption of transport and other forms of energy consumption.

In this study only the most common forms of Finnish tourism were studied. A lot of research is needed to examine other types of tourism, especially international tourism, since air travel is increasing quickly and at the same time the distances travelled are growing. There also exist many

other types of tourism. For example, camping is worthy of attention. It would also be interesting to study the material intensity of restaurant services and different kinds of activities.

In Finland, free time residences play a major role in leisure travel. Especially now that expectations in respect of the facilities in residences are growing it is important to find resource efficient technical solutions and to discuss expectations related to free time residences for new and old residences. At the moment the VAPET-project by the Finnish Work Efficiency Institute (Työtehoseura) is making a contribution to this (Kasanen, 2006). However, as the results of this study show, we should in addition to technical solutions also rethink our needs and our requirements. This calls for innovations in marketing and attitudes for the acceptance of smaller, less well equipped and shared free time residences.

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