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A survey of recycling behaviour in households in Kiruna, Sweden

The disposal of solid waste is quickly becoming a severely logistic and costly problem in many countries. While Sweden is usually considered to have a fairly successful recycling programme, this varies from region to region. This paper is an initial attempt at characterizing this regional variation. In this study, the recycling behaviour of a representative sample of 1193 individuals from Kiruna, the northern most municipality of Sweden, is investigated. It is observed that the propensity to recycle differs from the results obtained by other studies in different municipalities. Some potential reasons for this are mentioned. The data in this study are analysed using simple descriptive analysis and recycling behavioural models are estimated using logistic regressions. It was found that many socio-economic factors, such as sex, marital status, number of children, type of house one lives in, house ownership, location of where one lives (within town or outside town), size of house, employment status and salary, were not significant in explaining recycling behaviours of most components of wastes.

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1 Introduction

The disposal of solid waste is quickly becoming a severely logistic and costly problem in many countries. Incineration, although it can be used to recover energy, is more costly than landfills and in addition still produces toxic emissions and hazardous ash, in spite of improving technology. A viable alternative to managing solid waste is recycling, although the cost of recycling can be high (Criner & Kezis 1995; Powell & Graighill 1996). Recycling is important because a long-term nationwide recycling action extends and conserves scarce resources (Hornik & Cherian 1995). There are also many other benefits associated with recycling, but the major ones are reducing the waste stream destined for landfills or incineration, saving natural resources and energy used in the production of new goods, and lowering pollution levels (Reams & Geaghan 1996). It is no wonder that in the last two decades the factors affecting recycling behaviour have been extensively researched and more than 400 articles about waste disposal have been published (Tasaday 1991).

Much work has been done on the motivations behind recycling (see Section 2). Several variables have been tested using a range of statistical methods. However, there are only a few studies that have looked at regional or causal differences for such types of motivations. In this paper, recycling behaviour in a municipality in Sweden is examined. The aims are two-fold. In the first instance an initial attempt at characterizing regional variation in recycling behaviour is made. Reasons for this difference are hinted at without finding a formal causal relationship. In the second instance the versatility of logistic regressions from the family of Generalized Linear Models (GLM) are used to investigate behavioural attributes towards recycling some of the components of waste. In such studies, sometimes only

some simple descriptive analysis is used. In this paper, this method is augmented using the modelling approach based on logistic regression.

2 A review of some studies on recycling behaviour

A range of statistical methods has been used to study the motivation behind recycling, but the results are equivocal. For example, Heinen (1995) argued that policies that affect relative costs and benefits to individuals are the most important with regard to solutions to various environmental issues. On the other hand, Lee *et al.* (1995) argued that prior behavioural experience and commitment have a powerful effect on subsequent behaviour and can thus promote increased recycling behaviour. This is in line with arguments from Allen *et al.* (1993) who maintained that financial reward could increase the frequency of recycling but could not modify recycling behaviour. This is a contradiction to Pieters (1991) who stated that financial incentives and legislation are necessary ingredients of environmental policy.

Other studies such as Taylor & Todd (1995) have used an integrated model to show that attitudes strongly influence garbage reduction. Attitude is related to societal benefits such as helping the environment and the perceived complexity of the process. Self-efficacy, which means a belief that one can make a difference, is also important. This is in agreement with Mainieri *et al.* (1997) as they showed that consumer beliefs, for example, belief in the benefits of green buying, among middle-class urban communities are significant predictors for pro-environment behaviours. The same observation was made by Chung & Poon (1996) who found that ease in sorting and in the recycling process improves recycling behaviour. Larsen (1995) also arrived at the same conclusion by finding a positive relationship between propensity to recycle and personal responsibility and broader social concern.

Time use and perceptions about availability of time are important factors in solid waste management according to Godbey *et al.* (1998). Lansana (1993) found that residents in suburbs expressed more concern about personal time involved in the recycling process than those in urban areas.

A different line of thought is provided by Tucker (1999) who argued that pro-environment behaviour such as recycling can be influenced by social pressures from family, friends or neighbours, when a threshold of participants is overcome. He added that awareness of the programmes was also an important factor. Vining *et al.* (1992) found that altruism is the most important motivational factor for recycling. Personal inconvenience and household storage issues were rated moderately important factors, while social issues and economic incentives trailed in importance as recycling motives. This line of thought is shared by Berger (1997) who found size of residence area, type of dwelling, education and income to be very important determinants of access to recycling facilities. He also found that those who recycle are more likely to participate in other environmental behaviours.

Other related studies looked at assessing incentive-based environmental policies (Nestor & Podolsky 1998) or the participation of households in source reduction (Lober 1996) or in the model of change in environmental management (Hadfield & Seaton 1999).

3 Background

Kiruna is the biggest municipality in Sweden. It covers an area of about 20 000 km^2 and is situated above the Arctic Circle. In 1998, it had a population of 25 148 inhabitants. Until a few years ago Kiruna was known as the 'the mining town', but now it is referred to as 'the space city' and 'the winter city', referring to the transfer of activities from iron mining to space, environmentally related research and tourism. Space research operations are a result of the location of settlements to the far north. Environmental research and tourism strives on the rich fauna and flora in the neighbourhood. A map showing the location of some the municipalities mentioned in this section is given in Fig. 1.

In 1994 the Swedish government passed a law whereby producers were made responsible for collecting recycled packages (Naturvårdsverket 1998). Today all household waste is incinerated unsorted in Kiruna. Burning waste is used to produce 5% of the heating consumption of houses in Kiruna. Large containers to recycle paper, cardboard and glass exist at 20 recycling stations, half of which are situated in the town. The rest are found in villages around the town. There are no such recycling stations for metal and rigid polythene yet. Batteries can be deposited at supermarkets or gas stations. Dangerous waste, such as paint waste and detergents, can be left at an environmental station at the heating plant. Many studies have been made by the Kiruna municipality about the strategic location of the containers so as to minimize the distance households have to travel for recycling purposes. Unlike many other municipalities in Sweden, there is no weight-based billing system for house-

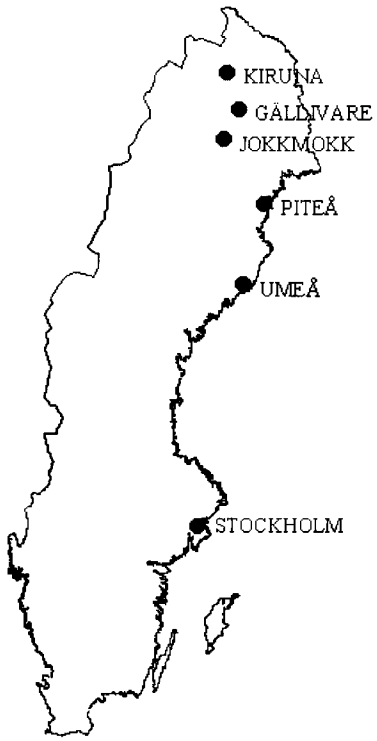

Fig. 1. A map showing the municipalities of Sweden mentioned in the text.

hold waste collection (Sterner & Bartelings 1999). There are no financial incentives for recycling, except for aluminium cans and plastic bottles, which have legislative charges that are refunded when they are returned at automatic machines in supermarkets. Furthermore, households in Kiruna are not provided with containers to sort wastes in their homes, as available in some other countries (Pieters 1991).

An environmental project called 'Nordic waste free future' was planned in co-operation with neighbouring municipalities, Gällivare and Jokkmokk. Kiruna would incinerate the combustible waste from the three municipalities; Gällivare would take care of compostable waste at a large composting plant; Jokkmokk would make granulated material using the 'bioash' from Kiruna and Gällivare. This project has not been realized due to lack of support from the Ministry of Environment. Then Gällivare municipality pulled out of the project and so did Jokkmokk. The mishaps of this project are regularly discussed in the local newspaper. Another well-publicized debate is whether it is best to burn paper at the heating plant rather than transport it approximately 300 km by lorry to be recycled. It is believed that this lack of co-ordination between the policy makers is an important factor in the regional differences between the municipalities.

Sweden is very advanced in the collection and use of waste paper. The rate of collection in Sweden, defined as the quantity of paper collected in relation to paper consumption, is about 50%, which is higher than the average of about 43% in Western Europe (Anon 1996). According to a report from the Swedish Environmental Protection Agency, the required levels of recycling in Sweden for 1997 were reached regarding paper, cardboard packages, glass, rigid polythene and aluminium cans, but not for aluminium packages and plastic bottles. Waste paper was recycled to 78%. Stjernström & Svensson (1991) did a survey on household participation and their preferences concerning environment, value of life and contribution. More than a thousand households were surveyed in the municipalities of Umeå and Piteå. Seventy-five percent always recycle paper, while 60% always recycle glass. Twenty-nine percent did not recycle household chemicals and 35% did sometimes. They pointed out that the households were best at sorting waste, such as paper, which is least dangerous to the environment. They also found a strong correlation between sorting propensity and awareness of environmental issues, but other issues such as time spent in the sorting process and the effort required for recycling were also important. Sterner & Bartelings (1999) found in a municipality south-west of Stockholm that people claimed to recycle about 90% of their glass, paper, batteries and even hazardous waste. Attitudes towards recycling seem to be very different in Kiruna from the rest of Sweden, as the figures for propensity to recycle different components of waste are very different from the national and regional figures.

4 Scope of this study

A random sample of 2000 individuals, aged 20 to 74-years-old was used for this project. This represented an 8% sample with a maximum error of 0.01 in the proportions. Furthermore, as described in the next section, the sample was fairly representative as the socio-economic characteristics of the respondents matched those of the population of Kiruna. Half of the individuals were from the town of Kiruna and the rest were from villages scattered around the town but within the municipality. A code was used to differentiate between these two groups. The questions were designed in collaboration with social scientists at Umeå University. The questions can be divided into three groups: those that enquired about the socio-economic characteristics of the respondents, those that determined the propensity to sort and recycle different types of wastes, and finally those that enquired about attitudes to different environmental issues. A copy of the translated questionnaire is given in Appendix A.

A pilot study was done on 30 people to test the validity and the appropriateness of the questions. The questionnaires were then sent out at the beginning of May 1998 with the promise of a lottery ticket for every returned questionnaire. The first reminder was sent four weeks later and the second reminder another four weeks later. Only 10 people phoned to ask for clarifications and to complain about the questions. Most of the complaints were about the question on earnings.

Out of the 2000 questionnaires sent, 1203 were received back, but 10 of them were blank or contained too many missing values. So the analysis was made on the remaining 1193 completed questionnaires. The response rate was thus 59.7%.

Table 2. Number of respondents classified by age groups

Age (years)	Frequency
18 to 19	23
20 to 24	76
25 to 29	108
30 to 34	133
35 to 39	129
40 to 44	115
45 to 49	125
50 to 54	122
55 to 59	103
60 to 64	105
65 to 69	81
70+	57
Total	1177

5 Descriptive analysis

The socio-economic characteristics of the respondents were compared with those of the population of Kiruna. The representation of women was well within the sampling error of 1.4%. There was a fair representation of the different age groups, with a slight over-representation of woman greater than 40-year-old and an under-representation of women in the age group 18 to 20-year-old. Similarly, there was a slight under representation of men in the age group 20 to 25-year-old and an over-representation of men in the age group 30 to 35-year-old. The discrepancy was not big enough to be corrected. However, there was a major over-representation of married people and this will be taken care of in further analysis. The discrepancies for the remaining variables were well within the sampling error. Some summary statistics of the raw data are given in Tables 1–4.

More than three-quarters (76.5%) of the respondents did not sort their waste and there was a slight difference between the sexes as more women sorted wastes. There was no clear trend between propensity to sort waste and age groups. The people who sorted their waste were married, had no children, and lived in a big house that they owned. They also had college education or higher, were retired or had relatively higher earnings.

Of the total respondents, 21.5% recycled paper, 53.9% recycled glass and 66.2% recycled environmentally dangerous wastes. Table 5 shows the number of respondents who recycled different types of wastes. Note that as aluminium and plastic bottles have legislative charges that are refunded when they are returned at automatic machines in supermarkets, they were not surveyed here. It is interesting to note that the proportion of people recycling paper is well below the national average of 78%. This might be a consequence of the polemic about whether to burn paper or recycle it (see Section 3).

As can be seen from Tables 5 and 6, the perception of which waste is most or least urgent to recycle is consistent with the number who actually recycles some type of waste. In all three cases (paper, glass and environmentally dangerous waste), ease of use of the recycle stations was a major positive factor on propensity to recycle (Table 7). Slightly less than

Table 1. Number of respondents classified by sex

Sex	Frequency
Male	602
Female	581
Total	1183

Table 3. Number of respondents classified by highest education reached

Highest education level	Frequency
Elementary School	348
Upper Secondary school	419
Adult Education	75
University	179
Other	156
Total	1177

Table 4. Number of respondents classified by monthly salary

Monthly earnings (Krona)	Frequency
0 to 6999	203
7000 to 8999	270
9000 to 10999	250
11000+	298
Total	1021

Table 5. Propensity to recycle different types of wastes. The categories 'often' and 'always' were taken as an indication that the person actually does recycle

Answer	Paper	Cardboard	Glass	Metal	Packaging	Paint waste	Compost
Never	609	717	259	656	754	171	796
Seldom	132	134	80	147	161	64	76
Sometimes	178	119	200	133	117	156	124
Often	107	75	197	78	57	186	79
Always	146	106	434	129	55	580	87

half of the respondents wanted the recycling stations to be in a residential area. Distance from the nearest waste station was a major negative factor for recycling paper and glass but was not important for recycling environmentally dangerous waste. The type of transport used to travel to the recycling stations only had an impact on propensity to recycle paper. People who tend to use public transport (which is not easily available in Kiruna) or a bicycle rather than a car also tend to have much higher propensity to recycle paper and glass.

Less than 50% buy environmentally marked products. Proclivity to purchase environmentally marked products had a positive correlation with propensity to recycle glass and environmentally dangerous products. Less than a quarter of the respondents buy products with unnecessary packing, and this factor did not correlate to the propensity to recycle either paper, glass or environmentally dangerous products. Less than half avoid using disposable articles and this was a major factor on the propensity to recycle all three wastes.

Concerning attitudes and perceptions of the respondents to different environmental issues, it seems that most people are interested in environmental issues but they seem to be confused on some issues. On the other hand, most people believe that it is best to burn paper rather than recycle it. Another interesting thing is that newspaper readership (77% read at least one newspaper) did not affect recycling propensity. Respondents who avoid littering have a higher propensity to recycle.

6 Statistical analysis

The data were further analysed using logistic regression (Hosmer & Lemeshow 1989). Over the last decade, the logistic regression model has become, in many fields, the standard method when the response variable is discrete, taking on two or more possible values. It is a particularly powerful method, compared with discriminant analysis for example, when the explanatory variables are categorical (Maddala 1993). In this modelling approach, four response variables were investigated: propensity to sort wastes and propensity to recycle paper, glass and environmentally dangerous waste. The groups 'Never', 'Seldom' and 'Sometimes' were merged together and was considered to indicate that the person does not recycle. Similarly, the groups 'Often' and 'Always' were pooled and taken as an indication that the person does recycle (see Table 5). This rescaling produced four binary variables that were used as the response variables in the four logistic regressions mentioned below. The regressions tested were hierarchical[1] and the socio-economic variables were always entered first. The removal or inclusion of variables was done manually, based on the log likelihood and the Wald statistic. This is a standard approach that examines the contribution to the log likelihood of introducing or removing a variable. The significance of the variable is also examined through the significance level of the Wald statistics. This probability should be less than 0.05. In many cases, this process of variable selection is usually done automatically using stepwise regression, but a manual approach gives a better feel of the model. For a discussion of the approaches used to estimate the logistic regression, see Hosmer & Lemeshow (1989) for an elaborate description or Hutcheson & Sofroniou (1999) for a non-mathematical description. Table 8 provides a list of the explanatory variables used, gives a short description about them and describes the type of the variable.

6.1 Results of the logistic regression

The results from the descriptive statistics were augmented by estimating behavioural models for recycling propensity. It is interesting to note that for the propensity to sort wastes, socio-economic variables such as sex, marital status, number of children, type of house you are living in, house ownership, location of where you live (within town or outside town), size of house, employment status and salary were not

[1]The term hierarchical is a statistical one and means that each term in the regression includes all lower order terms.

Table 6. Perception of urgency to recycle particular types of waste

Component	Most urgent Frequency	Least urgent Frequency
Paper	77	690
Corrugated cardboard	25	140
Glass	232	50
Metal	141	63
Packaging	98	65
Paint waste	944	25
Compost	18	90

significant. This is in contradiction with the results from other studies (see Section 2).

As with all the regressions, curvature on response due to age was determined. For example, in some cases there may be an age where the propensity is a maximum and beyond that point it starts decreasing. This is usually tested by including either age-squared or different groupings for age, but they were not significant. This indicates that there is a linear relationship between propensity to sort waste and age. In the case of education level, different types of grouping were tested. The best grouping was a division into elementary education or less, and higher than elementary education. In the summary below, the variables are listed by decreasing order of importance as measured by the Wald statistics, which has the same distribution as a χ^2. In modelling the propensity to sort waste, one explanatory variable that was used was willingness to sort waste. One reason for including this variable was because the authors wanted to add a variable of goodwill in the model. It was decided to keep it as its inclusion (or exclusion), did not affect the significance of the other variables.

Tables 9–12 list the parameters of the best logistic regression obtained, together with some diagnostic tests. In an ordinary linear model the value of R^2, the coefficient of determination, is usually quoted together with the parameters of the model. In the case of logistic regression, different diagnostic statistics are used. Only two are mentioned here. The log-likelihood statistic provides a measure of goodness-of-fit. This statistic is usually quoted as –2 times the log-likelihood (– 2LL) as this has approximately a χ^2 distribution. The interpretation of – 2LL is quite straightforward: the smaller the value, the better the model fit. The initial –2LL gives the value for the null model, whereas the final value is for the fitted model. The greater the difference between these two values, the better the model is.

A classification table provides another simple goodness-of-fit statistic. The predictive efficiency of a model can be calculated by comparing frequencies observed in the sample to those that are predicted by the model. When dealing with a binary response variable, this information is presented in a 2 by 2 contingency table. However, as the predicted values are along a scale of 0 to 1, but the true value is binary, a cut-off value is needed to rescale the predicted values to a binary one. This cut-off value depends on the proportion of respondents who actually recycle that particular component of waste.

Propensity to sort waste (Table 9):

- increases with willingness to do so;
- increases with age;
- increases if the person avoids using disposable products;
- increases if the person is inclined to purchasing environmentally marked products;
- is higher if the education level is greater than elementary school;
- increases if the person has a strong interest in environmental issues;
- increases if the person tends to use public transport or a bicycle rather than a car.

The propensity to recycle paper (Table 10):

- decreases with the distance of the residence from the nearest recycling station;
- increases if the person strongly believes that paper is best recycled rather than burned;
- increases if the person tends to avoid using disposable products;
- increases if the person has a strong interest in environmental issues;

Table 7. Ratio of recyclers to non-recyclers classified by ease of use of waste station for three components of waste

	Ratio of recyclers to non-recyclers for		
Ease of use of waste stations	Paper	Glass	Dangerous waste
Easy	0.3	1.5	2.4
Difficult	0.2	0.8	1.2

Table 8. List of the explanatory variables used in the logistic regressions

Variable name	Description	Type
Age	Age of the respondent	Continuous
Burnpaper	Belief of respondent about whether paper should be recycled or burnt	0 = paper should be recycled 1 = paper should be burned
Child	If respondent has a child or not	0 = has a child 1 = does not have a child
Dispose	Whether respondent avoids using disposable products	0 = Avoids such products 1 = buys such products
Dist	Distance of residence from nearest recycling station. The grouping is based on the three quartiles	0 = 0 to less than 300 m 1 = 300 to less than 500 m 2 = 500 to less than 1500 m 3 = greater than 1500 m
Earning	Earnings of a respondent in Krona. The grouping is based on the three quartiles. 1 dollar = 8 Krona	0 = 0 to less than 7000 1 = 7000 to less than 9000 2 = 9000 to less than 11000 3 = more than 11000
Ease	If respondent believes that the recycling stations are easy to use	0 = Easy to use 1 = Not easy to use
Education	Highest education level of respondent	0 = Elementary School 1 = more than elementary school
Envprod	Whether respondent prefers environmentally marked product	0 = prefers such products 1 = buys any products
Interest	If the person has strong interest in environmental issues	0 = No interest in these issues 1 = Strong interest in such issues
Location	If respondent believes that the recycling station should be in town	0 = station should be in town 1 = station need not be in town
Ownership	If respondent owns his house	0 = Owner 1 = Proprietor 3 = Tenant
Public	Whether respondent mostly uses public transport or bicycle	0 = Uses public transport or bicycle 1 = Uses car
Willsort	If respondent is willing to sort waste	0 = Willing to sort waste 1 = Not willing to sort waste

Table 9. Parameters and diagnostics for the model for propensity to sort wastes

Variable	Parameter value	Standard error	Wald statistics	Significance (p-value)
Age	0.0258	0.0063	16.6036	0.0000
Education	0.5122	0.2052	6.2303	0.0126
Public	0.3935	0.1927	4.1682	0.0412
Dispose	0.6888	0.1740	15.6799	0.0001
Envprod	0.4339	0.1715	6.4008	0.0114
Willsort	1.4848	0.1820	66.5449	0.0000
Interest	0.4121	0.1852	4.9504	0.0261
Constant	− 4.2176	0.4106	105.5214	0.0000

−2 Log-likelihood: Initial: 1112.1193; Final: 899.823.

Classification table with cut-off value of 0.25

Observed	Predicted 0	1	Percent correct
0	586	187	75.81%
1	72	169	70.12%
Overall			74.46%

Table 10. Parameters and diagnostics for the model for propensity to recycle paper

Variable	Parameter value	Standard error	Wald statistics	Significance (*p*-value)
Location	0.3972	0.1812	4.8049	0.0284
Burnpaper	− 0.8075	0.1740	21.5412	0.0000
Public	0.5100	0.1966	6.7264	0.0095
Dispose	0.6451	0.1795	12.9119	0.0003
Interest	0.4876	0.1830	7.0971	0.0077
Dist			31.6402	0.0000
Dist (1)	− 0.1246	0.2675	0.2168	0.6415
Dist (2)	− 0.4789	0.2212	4.6860	0.0304
Dist (3)	− 1.5221	0.2862	28.2779	0.0000
Constant	− 0.9979	0.2407	17.1837	0.0000

−2 Log-likelihood: Initial: 933.39161; Final: 820.041.

Classification table with cut-off value of 0.25

Observed	Predicted 0	1	Percent correct
0	405	201	66.83%
1	66	145	68.72%
Overall			67.32%

- increases if the person tends to use public transport or a bicycle rather than a car;
- decreases if the person believes that the recycling station should be in centre of town or in residential areas.

The propensity to recycle glass (Table 11):

- decreases with the distance of the residence from the nearest recycling station;
- increases if the person has a strong interest in environmental issues;
- increases with age;
- increases if the person is inclined to purchasing environmental products;
- is higher if the education level is greater than elementary school;
- increases if the person does not have a child;

Table 11. Parameters and diagnostics for the model for propensity to recycle glass

Variable	Parameter value	Standard error	Wald statistics	Significance
Age	0.0199	0.0063	10.1533	0.0014
Education	0.5473	0.1872	8.5452	0.0035
Location	0.3923	0.1549	6.4108	0.0113
Child	− 0.4670	0.1636	8.1462	0.0043
Envprod	0.4893	0.1590	9.4727	0.0021
Interest	0.7760	0.1736	19.9870	0.0000
Dist			22.2245	0.0001
Dist (1)	− 0.1602	0.2602	0.3791	0.5381
Dist (2)	0.1241	0.2161	0.3295	0.5660
Dist (3)	− 0.7465	0.2276	10.7571	0.0010
Constant	− 1.1357	0.4009	8.0254	0.0046

−2 Log-likelihood: Initial: 1101.2606; Final: 998.130.

Classification table with cut-off value of 0.60

Observed	Predicted 0	1	Percent correct
0	213	112	65.54%
1	164	331	66.87%
Overall			66.34%

Table 12. Parameters and diagnostics for the model for propensity to recycle environmentally dangerous waste

Variable	Parameter value	Standard error	Wald statistics	Significance
Age	0.0124	0.0069	3.2839	0.0700
Ease	− 0.7410	0.2288	10.4854	0.0012
Envprod	0.7445	0.2083	12.7765	0.0004
Ownership			8.2405	0.0162
Ownership1	0.3577	0.3681	0.9442	0.3312
Ownership2	− 0.5193	0.2153	5.8187	0.0159
Dispose	0.4628	0.1981	5.4559	0.0195
Interest	0.4717	0.2337	4.0727	0.0436
Earning			18.0801	0.0004
Earning(1)	0.2381	0.2574	0.8557	0.3549
Earning(2)	0.4840	0.2744	3.1110	0.0778
Earning(3)	1.1468	0.2859	16.0913	0.0001
Constant	− 0.0596	0.3834	0.0242	0.8764

−2 Log-likelihood: Initial: 789.79091; Final: 702.377.

Classification table with cut-off value of 0.76

Observed	Predicted 0	1	Percent correct
0	101	63	61.59%
1	185	405	68.64%
Overall			67.11%

- decreases if the person believes that the recycling station should be in the centre of town or in residential areas.

The propensity to recycle environmentally dangerous products (Table 12):

- increases with earnings;
- increases if the person tends to purchase environmental products;
- increases if the person thinks that the recycling stations are easy to use;
- increases if the person owns his house;
- increases if the person avoids using disposable products;
- increases if the person has interest in environmental issues;
- increases with age.

7 Conclusions

In this paper the recycling attitudes of a sample of residents in a municipality of Sweden were examined. It is shown that the propensity to recycle paper and to sort waste are much lower than the national averages. On the other hand, the residents are very active in recycling environmentally dangerous wastes although this may mean travelling long distances to do so. More importantly, however, the propensity to recycle paper, glass and environmentally dangerous wastes do not depend on many socio-economic factors. Another major result is that the factors that are important in propensity to recycle paper, for example, may not be significant to that of recycling glass.

While there was no attempt at checking for false reporting in the survey, discrepancy between the answers of some of the questions were checked. None were found indicating that false reporting was either low or systematic. Furthermore, given the interest that the respondents had in the survey and the closeness of the Kiruna community, it is believed that false reporting was fairly low. The unique characteristics of this municipality makes it difficult to extrapolate the specific results of this paper to other municipalities or countries, but the whole picture behind waste recycling in Kiruna has been described as far as possible. It is hoped that other researchers can recognize particular aspects that are similar to theirs and either use the results directly or for comparison. However, it is believed that the more general results, as described in the next paragraph, are directly applicable to other countries.

There have been many studies on the behavioural attributes of recycling behaviour. However, many of the results are equivocal (see Section 2). While this is probably not uncommon in the social sciences, it is important, for the efficient uptake of some of these results in policy actions,

that the reasons behind these discrepancies are examined. One of the contributions of this paper is to point at regional differences in recycling behaviours in Sweden. However, more intensive comparison is required and more elaborate explanation as to why these differences occur is needed. Here it is hinted that any regional discrepancies may be related to different policy actions (or billing practices) or well-publicized polemic among decision makers.

It is also suspected that the equivocal results found in the literature may be related to the range of statistical methods used. In many cases, the weaknesses of some of the methods used and the statistical assumptions that may invalidate the results are usually not examined thoroughly. It is hoped that the family of Generalized Linear Models will become a standard tool for such studies. Another reason for the equivocal results of other studies may be related to one of the results of this paper, which indicated that the motivation behind the recycling behaviour of different components of waste are different and should be treated separately.

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Appendix A: Questionnaire

SMC
KIRUNA

The Spatial Modelling Centre (SMC) has the jurisdiction to undertake an investigation in Kiruna's municipality. The research aims at describing residents' attitudes to sorting and recycling and also to what extent sorting is done.

Garbage and recycling material can be sorted in different categories. Sorting different wastes by considering their differences make it easy to handle them properly. Due to the packaging law from 1 October 1994, the packaging producers are responsible for the packaging, even after they have been used. The packaging that is considered is glass, corrugated cardboard, steel plate and aluminium. The so-called environmental dangerous wastes include garbage that contains oil, solvent, paint, glue, certain metals and insecticides. Among metallic environmental toxic wastes are lead, cadmium and mercury, which are the most dangerous.

It is important for the research quality and also constantly interesting for the municipality and the companies that handle wastes to know how you as the consumer takes care of different categories of wastes (mentioned above). The research questions deal therefore with your attitudes to sorting and recycling wastes and also to what extend sorting is done.

In a completely random choice 2000 citizens have been selected to participate in this research. Your participation is obviously voluntary. **The collected data will be treated confidentially**. The data collected will be computerized without personal information and the results will be presented as group data in tabular form. So possibilities of identification are impossible. Your questionnaire bears a number, so that I know if you have sent it back. Therefore I will not send you a reminder unnecessarily.

Enclosed is a post-free return envelope for you to send back your filled in questionnaire. Send it as soon as possible. As a thank you for your participation you will be sent a lottery ticket (trisslott).

If you have any enquiries, I will gladly answer your questions. You can reach me on either telephone number 0980-67000 (SMC) or 0980-80611 (home).

Thank you beforehand for your co-operation.

Kiruna, April 1998-11-11
Thomas Brännström
Research assistant
SMC

SMC is one of the four research and development programmes, which belong under the Environment and Space Institute (MRI). The otheres are Data Environmental Centre (MDC), Research on the Atmosphere (AFP) and Climatic Research (CIRC). The research programmes that are undertaken by SMC: partly aims at new modern geographical information within social science and at applications that are concerned with adapation and further development of techniques.

Most of the questions are multiple-choice. You select your answer by putting a cross in the suitable square. For some questions you will maybe find it difficult to choose a definitely correct answer. There is space for you to add comments.

Aldrig – never; sällan – seldom, rarely; ibland – sometimes; ofta – often; alltid – always.

1. How often do you sort your wastes? Aldrig sällan ibland ofta alltid

2. How often...

a. do you hand over paper to recycle?
b. do you hand over corrugated cardboard to recycle?
c. do you hand over glass to recycle?
d. do you hand over metal to recycle?
e. do you hand over packaging to recycle?
f. do you hand over environmentally dangerous waste to recycle?
g. do you compost?

3. a. Which type of wastes (see the list above) do you think is the most urgent to hand over?
b. Which type of wastes (see the list above) do you think is the least urgent to hand over?

4. Do you think it is easy or difficult to see what and where to put the wastes in the garbage stations.
Easy, very easy, very difficult, difficult

5. Where do you think it is most convenient to have the waste stations?
Residential area
Shop, post or the likes
Filling station
Others, specify.....

6. How far are you from the nearest waste station? .....meter ..... don't know

7. How do you usually go to the waste station? Walk, cycle, car

8. Do you go by bicycle or public transport instead of the car?
Never, rarely, sometimes, often, always

9. Do you usually take your waste while you are doing something else or do you go specifically to the waste station?
In association with something else, an extra tour
10. How often do you buy environmental mark products?
Never, rarely, sometimes, often, never
11. How often do you buy products with unnecessary packaging?
12. Do you avoid using disposable articles such as disposable mug, disposable safety razors, plastic bags, etc.?
13. Do you agree with the following statements?
No absolutely not, No uncertain, Neither or, Yes perhaps, Yes definitely
a. I think that new techniques can decrease environmental problems.
b. I think it is better to burn the paper in the municipality heating plant rather than transport it to the paper mill.
c. I am mostly worried by thinking that future development will increase environmental problem.
d. I think that in big town areas there is a need to have a lot more wastage sorting than in clean and thinly populated areas.
e. Environmental questions interest me.
f. I think that altering attitudes and having a set of values can reduce the environmental problem.
g. I am willing to hand in dangerous environmental waste.
h. I am willing to compost.
i. I am willing to travel less by car.
j. I am willing to pay more taxes so that money can be used for environmental purposes.
k. I am willing to choose environmental mark articles.
l. I am willing to sort wastes.
m. I have a highly positive opinion on community development.
14. How large is the daily newspaper and evening paper readership in your house?
None, one newspaper/day, two newspapers/day, three or more newspaper/day
15. Do you avoid throwing rubbish on the roads and the square?
Never, seldom, sometimes, often, always

Background

The last section will collect some personal data. These data are important for analysing the data in the previous section. **Put a cross** in the selected square.
16. Sex: Male, Female
17. In what year were you born?
Year .....
18. Civil status
Married, Sambo (living together), Single
19. How many children are living at home?
None, one, two, three or more
20. How do you live? (house type)
Small house (block of flats with pair, row or linked house)
Other house (apartment)
Others
21. How do you live?
proprietorship, tenants, renting from landlord
22. How do you live?
Number of rooms/occupied surface area
.... room and kitchen
.....km^2
23. What educational qualification do you have? Give the highest educational qualification.
Elementary school
Upper Secondary school
Residential college for adult
University
Other (please specify)
24. Are you presently
Employed? Fulltime, Part-time
Non-employed? Student/military service, unemployed, retired, premature retirement, other reason
25. What is your monthly salary after tax deduction?
.....Kr