

НИЙГМИЙН ИННОВАЦИ

A STUDY ON FACTORS INFLUENCING BEHAVIOR BEHIND SORTING OF HOUSEHOLD WASTE: IN CASE OF ULAANBAATAR CITY

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Abstract: *The main objective of this study was to investigate the factors affecting the behavior behind sorting of household waste. The stated behavior was applied as an indicator of behavior behind sorting of household waste. The sample for study was drawn from the residents of UB city (Ulaanbaatar city). The information was collected by well-designed questionnaire from residents. The dependent variable was stated behavior. The general six independent variables included attributes of the resources, institutions in the neighborhood, individuals' characteristics, knowledge, motivation and habits (totally sixteen independent variables). The statistical method of analysis applied for testing the association and the factors affecting sorting stated behavior in the residents was ordinal logistic regression. The results revealed that economic incentives (motivational factor), personal norms (motivational factor), cognitive dissonance (individual characteristics), income (individual characteristics), education (individual characteristics), housing type (attributes of the resource), attitude towards regime (knowledge) and habits are found to be more significantly associated with stated behavior of residents.*

Key Words: *Stated behavior, residents, independent variables, ordinal logistic regression*

INTRODUCTION

Ulaanbaatar city covers an area of 4704 km² and has a population of about 1.5 million. Each district has established a general maintenance company /GMC/. They response the refusing collection, street cleaning, park and green area maintenance and development, and maintenance of public

buildings and private and governmental industrial organizations. Each district has apartment and ger areas; however, the proportion varies among them. People throw away 3900 tons of solid waste a day and 1,433,000 tons of solid waste a year in UB city. Currently, about 76% of the solid waste is disposed by landfill and only 24% or 344 tons by recycling. There are one sanitary landfill and two recycling in the city. Residents living in apartments produce 14%, while residents living in ger district produce 40%, in summary, households produce 54% or the highest percent of solid waste. Until recently, in UB city, sorting efforts have been a voluntary activity, mostly driven by moral obligation to contributing to a cleaner and healthier environment.

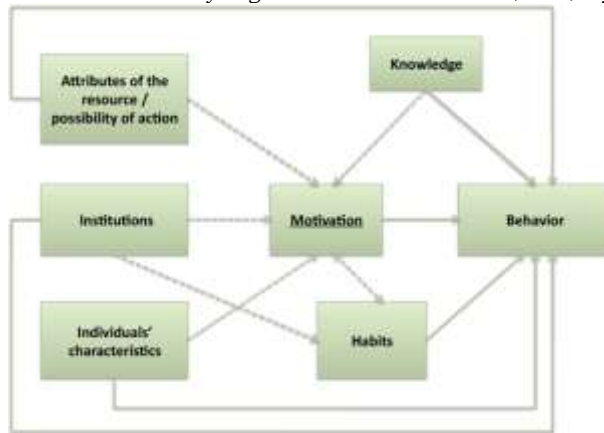
Mongolian National Recycling Association (MNRA): UB city has an estimated 800 ton/day of solid waste with a growth of 30% per annum. There is a lower level segregation at source. Three existing landfill sites have exceeded their capacity. At the moment, there's no existing Eco-Industrial Park in Mongolia. MNRA is working closely with Ulaanbaatar City to develop Eco-parks (cluster of recycling industries) in the vicinity of the dumpsites. The city has agreed to provide land plots to the association. MNRA requested technical assistance to carry-out a feasibility study of the eco-parks. The development of the proposed Eco-Industrial park is on initial stage in 2019, where partners collaborated for development of feasibility study. The City Mayor's Office, the Mongolian National Waste Recycling Association (MNRA) has mobilized recycling factories to establish an Eco-Park with the aim to address waste management problems in UB city, as well as provide jobs and build recycling facilities equipped with technological innovations.

This study was expected to show clear the possible of obtaining better utilization of the waste collecting system by identifying the key factors that affected the stated behavior of residents. Besides, the finding of this study was expected to solve the factors that affected the behavior of residents in this waste collecting system and it enables the residents to get best waste management.

THEORITICAL FRAMEWORK

According to the theory used, it has been relevant to develop a framework based on work by Vatn (2005) and Ajzen (1991). Vatn's (2005) framework for analyzing issues regarding use of resources is mainly depending on attributes of the resource and available technology, agents and agents' choices, institutions and, patterns of interaction. Ajzen's (1991) framework 'theory of planned behavior' holds subjective norms, attitudes and perceived behavior control to be of importance for the individual's intentional behavior because intention and perceived control are factors explaining behavior.

Figure 1. Framework for analyzing behavior. Source: Vatn (2005) Ajzen (1991)



PART OF RESEARCH

3.1 Data

The method of data collection in this study was primary source using questionnaire as instruments of data collection. Information about the households' motivation and behavior related to sorting of waste, has been collected through internet-based questionnaire. The sample exists of 145 randomly chosen households in UB.

3.2 Reliability analysis

Cronbach's alpha was used to see how closely related the items were as a group, and >0.7 indicates a relatively high internal consistency.

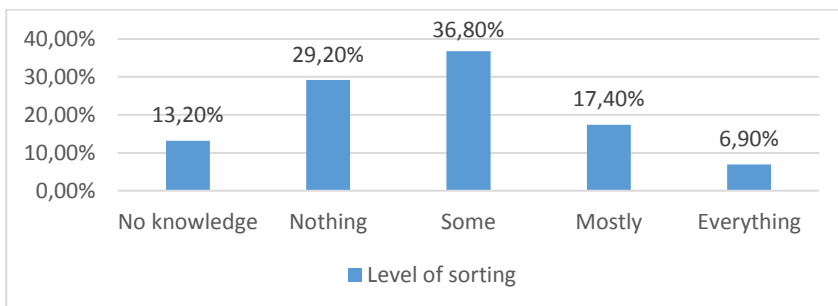
Table 1. Reliability analysis

Cronbach's Alpha	N of Items
.868	9

3.3 Variable of the study

The dependent variable was stated behavior of the residents, which was categorized as everything, mostly, some, nothing and no knowledge to sort.

Figure 2. Sorting level ("How much of your waste is sorted?")



We see that 6.9% sort everything, and 17.4% states they sort most of their household waste. This gives us 24.3% stating they have a high sorting level. But municipality need to provide more information for encouraging waste sorting at source because of 13.2% doesn't know how to sort and 36.8% has a rather low level of waste sorting, furthermore 29.2% doesn't sort anything all.

Independent variables that used in this study are motivation, individual's characteristics, attributes of the resources, knowledge, habits and institutions.

Table 2. List of independent variables with respective name and category codes

Factors	Independent variables	Value labels
Motivation	Economic incentives	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct
	Encouragement from the authorities	
	Social norms	
	Personal norms	
Individual's characteristics	Gender	__male __female
	Age level	__16-39 __40-66 __above 67
	Monthly income before tax /MNT/	__300.000 __300.000-600.000 600.000-900.000 900.000-1200.000 __1200.000-1500.000 __ above 1500.000
	Education	__Primary/secondary school __technical school __bachelor __master __doctor
	Cognitive dissonance	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct
	Number in household	__1 __2 __3 __4 or above 4
Attributes / control	Housing type	__ger district __flat __other
Knowledge	Environmental concern	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct
	Fee knowledge	__not important __don't know __know
	Attitude towards regime	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct
Habits	Habits	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct
Institution	Institutions in the neighborhood	0=don't know 1=not correct at all 2=correct a little 3=correct 4=very correct

3.4 Ordinal logistic regression

3.4.1 Assumptions of the ordinal regression

Logistic regression may be useful when we are trying to model a categorical dependent variable as a function of one or more independent variables being the dependent variable has two outcomes. Ordinal logistic regression (OLR) is type of logistic regression analysis when the response variable has more than categorizes with having natural order or rank.

In statistics, the ordered logit model (also ordered logistic regression or proportional odd model), is a regression model for ordinal dependent variable. It is natural to consider methods for more categorical response having more than two possible values. The most well-known of these ordinal logistic regression methods is called the proportional odds model. We decide about the rejection of H_0 that say there was no significant association between two variables. H_0 : There was significant association between dependent variable and independent variables Vs H_1 : Not H_0

- The dependent variable should be measured at the ordinal level.
- Ordinal independent variables must be either continuous categorical.
- There is no multicollinearity.
- Each independent variable has an identical effect at each cumulative split of the ordinal dependent variable.
- The relationship between each pair of outcome groups is the same.
- The effects of any explanatory variables are consistent or proportional across the different threshold.

3.4.2 Multicollinearity

Multicollinearity occurs when some of the independent variables used in the regression model are correlated with each other and contributes redundant information because one variable's contribution in the model is overlapping with another variable's contribution. To control for multicollinearity, I did a bivariate correlation to see whether some of the factors I got from the factor analysis were highly correlated (above 0.7), and to control for this in the regression, I removed the variables loading on more than one factor to avoid high correlations. Running a new correlation showed decreased values of correlation between these factors after this operation.

3.4.3 Ordinal logistic regression analysis

Ordinal logistic regression was a type of logistic regression analysis that when the response variable is categorized more than two with having natural order or rank. That is, we can rank the values, but the real distance between categories is unknown. Under ordinal logistic regression analysis, we can deal Model Fitting Information, Goodness-of-Fit, Pseudo R-Square, Parameter Estimates and Test of parallel lines.

Logit link function is used in the analysis because it is evenly distributed categories and is reasonable choices when the changes in the cumulative probabilities are gradual and logit involves all levels of the response and dichotomizes the response scale. The Model Fitting Information table, which gives the -2 log likelihood for the intercept only and final models can be used in comparisons of nested models.

Table 3. Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	420.201			
Final	342.510	77.691	16	.000

Link function: Logit.

The statistically significant chi-square statistic ($p < 0.05$) indicates that the Final model gives a significant improvement over the baseline intercept-only model. This tells us that the model gives better predictions than if we just guessed based on the marginal probabilities for the outcome categories. Therefore, the Full model (with factors that affect health status as a predictor) is significantly better than the 'stated behavior' model.

Table 4. Goodness-of-Fit Statistics

	Chi-Square	df	Sig.
Pearson	588.666	560	.594
Deviance	342.510	560	1.000

Link function: Logit.

From the above table the results for our analysis suggest the model does fit very well ($p > 0.05$) (i.e. fail to reject the null hypothesis depending on the observed data). Also, the model fits adequately. For logistic and ordinal regression models, it not possible to compute the same R2 statistic as in linear regression so three approximations are computed instead.

Table 5. Pseudo R-Square

Cox and Snell	.415
Nagelkerke	.439
McFadden	.185

Link function: Logit.

What constitutes a "often" R2 value depends upon the nature of the outcome and the explanatory variables. Here, the pseudo R2 values (e.g. Nagelkerke = 43.9%) indicates that there is relatively small proportion of the variation in stated behavior between residents. This is just as we would expect because there are numerous factors that affect stated behavior of residents.

To improve model fit we ran the ordinal logistic regression several times, dropping an insignificant variable at each step. By removing insignificant variables, the relationship between those left in the model may alter. I dropped the least significant variable at each step, and stopped when

there was no reason to remove another variable as the significance level of those left did not improve. There is also a strong association between factors that affect stated behavior, even when p-values are less than alpha level. We can see significant for economic incentives, personal norms, income, education, cognitive dissonance, housing type, attitude towards regime and habits.

In the Parameter Estimates table we see the coefficients, their standard errors, the Wald test and associated p-values (Sig), the 95% confidence interval of the coefficients and odds ratios.

Table 6. Ordinal logistic regression

		Ordinal logistic regression with stated behavior as dependent variable, 1st step	Ordinal logistic regression with stated behavior as dependent variable, 10th step		
		N=145 LRchi2 (16) = 78.876 Pseudo R2 (Nagelkerke) = .444 -2LL (sign.) = .000	N=145 LRchi2 (7) = 77.691 Pseudo R2 (Nagelkerke) = .439 -2LL (sign.) = .998		
Independent variables		Parameter estimates (coefficient)	P value	Parameter estimates (coefficient)	P value
Motivation	Economic incentives	.135	.002	.357	.000
	Encouragement from the authorities	-.058	.723		
	Social norms	.216	.125		
	Personal norms	.454	.045	.615	.002
Individual's characteristics	Gender	-.569	.248		
	Age level	-.640	.171		
	Monthly income before tax /MNT/	.166	.170	.263	.012
	Education	.199	.198	.615	.002
	Number in household	-.054	.787		
	Cognitive dissonance	.409	.062	.396	.033
Attributes / control	Housing type	1.684	.015	.018	.008
Knowledge	Environmental concern	-.146	.489		
	Attitude towards regime	.479	.056	.528	.012
	Fee knowledge	.010	.621		
Habits	Habits	.976	.000	.952	.000
Institutions	Institutions in the neighborhood	.018	.923		

Since p-value less than alpha level they are statistically significant: otherwise not. The thresholds are shown at the top of the parameter estimates

output, and they indicate where the latent variable is cut to make the five groups that we observe in our data. The threshold coefficients are representing the intercepts, specifically, the point (in terms of a logit) where stated behavior might be predicted into the four categories.

The estimates labeled location are the coefficients for the predictor variables. There appears to be relationship between stated behavior and the factors that affect stated behavior.

From the observed significance levels in above table, we can see that all explanatory variables are factors that affect stated behavior of residents. Based on the small observed significance level, we can reject the null hypothesis that it is zero. The estimates labeled Location are the ones we are interested in. They are the coefficients for the predictor variables. The Wald statistic is the square of the ratio of the coefficient to its standard error. The significance of the Wald statistic in the column with heading sig (< 0.05) indicates the importance of the predictor variables in the model (we reject the Null hypothesis $H_0: \beta = 0$) and high values of the Wald statistic shows that the corresponding predictor variable is significant.

Conclusion, the findings indicate that these the independent variables that have no significance association with stated behavior of a resident are encouragement from authorities, social norms, gender, age level, number in household, environmental concern, fee knowledge and institutions in the neighborhood. And economic incentives, personal norms, income, education, cognitive dissonance, housing type, attitude towards regime, habits are found to be more significantly associated with stated behavior of residents.

Table 7. Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	342.510			
General	318.240 ^b	24.270 ^c	48	.998

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

- A. The log-likelihood value cannot be further increased after maximum number of step-halving.
- B. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.
- C Link function: Logit.

From the above table shows parallel line test for general model with chi square value 24.270 and p value=0.998 which is greater than the 5% level of significance, **fail to reject** the null hypothesis. Therefore, there is no enough evidence to reject the null hypothesis for general model. Thus, the proportional odds assumption appears to have held for general model.

DISCUSSION

Based on the results of this study, we recommend a number of interventions to be put in place in municipality of UB city to increase sorting level of residents. These include:

- The municipality need to provide more information for encouraging waste sorting at source because of 13.2% of residents don't know how to sort and 36.8% of them has a rather low level of waste sorting, furthermore 29.2% doesn't sort anything all.
- The municipality should give emphasis on factors that affect stated behavior of residents.
- The residents of flat have some differences on sorting level when compared to residents of ger district. In order to address this deference, the municipality should give special regime for residents of ger district.
- The municipality should give attention to problems and report for the concerned sorting level to solve those problems.

CONCLUSION

The main objective of this study was to investigate the factors affecting stated behavior behind sorting of household waste in UB city. As we conclude this study was an attempt to examine the impact of some factors on the stated behavior of residents in UB city. The finding shows that the residents' behavior is affected by some factors during their life. Targeting this housing type group (flat) would comparatively increase the sorting level when compared to residents of ger district regarding to the observed data. In this analysis we have looked at regression models that can be applied when our outcome is represented by an ordinal variable. Furthermore, the findings indicate that behavior of residents is associated with economic incentives, personal norms, income, education, cognitive dissonance, housing type, attitude towards regime and habits. The independent variables that have no significance association with economic incentive, encouragement from authorities, social norms, gender, age level, number in household, environmental concern, fee knowledge and institutions in the neighborhood.

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