



Amount of Waste used for Different Purposes: A Socio-ecological Impact

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Authors' contributions

This work was carried out in collaboration among all authors. Author AG wrote the first draft of the manuscript, collected data and done statistical analysis. Author DP helped in collection of data and preparation of manuscript. Authors AB and SKA helped in interpretation and supervised the work. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2020/v10i930232

Editor(s):

(1) Dr. Wen-Cheng Liu, National United University, Taiwan.

Reviewers:

(1) Jonas Alexandre, State University of Northern Rio de Janeiro, Brazil.

(2) Castillo-Santa María, Bessy, César Vallejo University, Peru.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/59872>

Original Research Article

Received 27 May 2020

Accepted 03 August 2020

Published 10 August 2020

ABSTRACT

Waste is a ceaselessly developing issue at worldwide and territorial just as at neighborhood levels. Due to vigorous globalization and product proliferation in recent years, more waste has been produced by the soaring manufacturing activities. The social ecology of waste recycling implies the structural, functional and managerial intervention of waste generation process. The specific objective of the research was to isolate and identify the system variables characterizing and the management of waste recycling process and to estimate intra and inter level of interaction amongst and between the variables for respective, inductive and interactive contribution. The present study takes a look into the approach, process and impact of ongoing waste management process, followed by the both kalyani and jalpaiguri municipalities. A set of agro-ecological, socio-economic and techno managerial factors have been developed by selecting two sets of operating variables: Independent Variables: Age(x_1), Education(x_2), Family member(x_3), Total cost of energy(x_4), Household land(x_5), Income(x_6), Expenditure of family(x_7), Volume of waste generation per household(x_8), Water consumption per day(x_9), Total bio diversity(x_{10}), Impact of waste management on health(x_{11}), Impact of waste management on agriculture(x_{12}), Impact of waste management on livestock(x_{13}), Impact of waste management on water(x_{14}), Impact of waste

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management on soil(x_{15}), Impact of waste management on micro flora and fauna(x_{16}), Exposure to media(x_{17}), Training received(x_{18}), Participation on waste recycling programmer (x_{19}), Perception on environmental impact of waste management(x_{20}), Waste management at household level with value addition by percentage (x_{21a}), Waste management at household level with value addition by percentage (x_{21b}). Dependent variables: Volume of waste used for different purposes (y_1). The following independent variables have come out with stark contribution on this consequent variable. Result suggested that in terms of variable, behavior and responses there have been stark differences between jalapaiguri and kalyani municipal areas. In kalyani, some few variables like perception of environmental impact on waste management, waste management at household level with value addition by percentage, impact of waste management on agriculture have recorded the distinct contribution on volume of waste used for different purposes and in jalpaiguri total household land, volume of waste generation from household, water consumption per day have gone in the determinant way. So, in kalyani and jalpaiguri municipal areas these variables have maximum influence on the dependent variable. Household wastes mostly are bio degradable in nature. It can be converted to organic manure which has a great nutritional value for plants and if these bio wastes can be converted into organic manure then amount of waste will be reduced. Not only bio waste but we can use non bio degradable wastes for energy production also.

Keywords: *Waste management; ecology and waste management; ecological services; policy and waste management; social ecology; waste management.*

1. INTRODUCTION

Waste is a ceaselessly developing issue at worldwide and territorial just as at neighborhood levels. Due to vigorous globalization and product proliferation in recent years, more waste has been produced by the soaring manufacturing activities. The production of municipal solid waste represents one of the greatest challenges currently faced by waste managers all around the world [1]. This has contributed to the significant need for an efficient waste management system to ensure, with all efforts, the waste is properly treated for recycling or disposed [2]. Waste is a great concern in urban life in every city of the world. Developed cities of world are using modern disposal and recycling technologies as well as state of the art equipments and ensuring their dwelling neat and tidy [3]. Solid waste has been delivered since the start of human advancement. Rapid growth in population and urbanization coupled with diminishing land availability has aggravated the problems of solid waste management [4]. During the most punctual periods, solid wastes were advantageously and inconspicuously discarded in huge open land spaces, as the Density of the populace was low. In any case, today, one of the outcomes of worldwide urbanization is an expanded measure of solid Waste. The world paper industry produces a great amount of industrial solid waste that undergoes a treatment process that can be primary, secondary, or tertiary, in order to adapt the waste for correct disposal [5]. Electronic waste or E-waste is one of the main sources of

harmful toxic pollutants (polyvinyl chlorides, polychlorinated biphenyls, lead and mercury). E-waste also represents a potent source of valuable metals such as gold, silver, palladium, and copper [6]. Civil construction is responsible for the excessive consumption of natural resources and the generation of the largest share of solid urban waste [7]. Environmental contamination due to solid waste mismanagement is a global issue. Open dumping and open burning are the main implemented waste treatment and final disposal systems, mainly visible in low-income countries [8]. Most countries worldwide are making efforts to diversify their energy supplies, employing alternative sources of energy that can minimize environmental impacts. Wind power is especially attractive in most of the countries. One of the main components of wind generators is the turbine blade, which is essentially composed of a metal structure enveloped in glass fiber and epoxy resin, together with wood and adhesive. The waste replaced part of the aggregate (sand), consequently reducing the use of a natural resource (sand), and providing a suitable route for the disposal and use of the wind blade waste [9]. Kalyani Civil territory, that is 21 wards, was chosen for the investigation. In Kalyani town wastes the executives is a difficult issue and carefully need legislative concern. In kalyani civil territory around all out 52 Mt wastes produces every day. Jalpaiguri District zone, that is 1 to 25 wards, were chosen for the examination. In Jalpaiguri town, wastes the board is a major issue and carefully need administrative concern.

In jalpaiguri town roughly 52520 kg wastes delivered each day. Policy options that can be used to reduce generation of municipal solid waste and examined the direct and indirect effects of introducing unit-based pricing. Two types of unit-based pricing were distinguished: a full unit-based pricing scheme in which municipalities charge a variable price for collection of both organic waste and rest waste, and a selective unit based pricing scheme in which municipalities charge a unit-based price for the collection of rest waste [10]. The serious issue is that underestimation of age rates and in this manner, underestimation of asset necessities, absence of specialized and administrative sources of information, and absence of dependable and refreshed data to the public [11]. Wastes can make vindictive contamination to the earth. Inappropriate waste administration can make genuine wellbeing perils to the human and creature also. Natural contamination and decrease in long haul flourishing of urban wellbeing [12]. Inappropriate waste management additionally has some negative impact on economy.

2. RESEARCH METHODOLOGY

2.1 Locale of Research

The present study was conducted in two districts namely Jalpaiguri district and Nadia district. In Jalpaiguri district, Jalpaiguri Municipal area and in Nadia district Kalyani Municipal area were selected for the study. The area had been selected for the study because of there is a large scope for collecting relevant data for the present study, acquaintance with the local people as well as local language, The closure familiarities of the researcher with area, people, officials and local dialects.

2.2 Pilot Study

Before taking up actual study, a pilot study was conducted to understand the areas, its people, institutions, communication and extension system and the knowledge, perception level and attitude towards waste management practices and its impact on ecology.

2.3 Sampling Design

The state, district, sub divisions were selected using non-probability sampling technique called purposive sampling and the respondents were selected using simple random sampling method.

The two municipalities were selected purposively. Out of two municipalities total 150 respondents were selected, 75 respondents from each municipality from five respective locations (Vegetable market, Fish market, Hospital area, Railway stations, Ward area) were selected randomly for final data collection.

2.4 Preparation of Interview Schedule

On the basis of findings of pilot study a preliminary interview schedule was formed with the help of literature, and by the assistance of Chairman of Advisory Committee and subsequent discussion with the members of the advisory Committee.

2.5 Finalizing of Schedule after Pre-testing

The draft schedule for collection of data, incorporating the tools and techniques of different variables were presented twice each time on respondents. The quantification was done for each and every variable after operationalized them. Before starting final data collection, entire schedule was pretested for elimination, addition and alternation with respondents of the study area.

2.6 Techniques of Field Data Collection

This was personally interviewed during puja vacation and summer vacation. The items were asked in Bengali as well as English version in a simple term so that the members could understand easily. The entries were done in the schedule by student investigator himself at the time of interview.

2.7 Variables and Their Measurements

After reviewing various literature related to the field of study and consultation with the respected chairman of Advisory Committee and other experts, a list of variables was prepared. On the basis of selected variables, a schedule was formed.

2.8 Proper Description of Variables

2.8.1 Age(X_1)

In all societies, age is one of the most important determinants of social status and social role of the individual. Age of the head member of the family has only been considered for the purpose of the study.

2.8.2 Education(X_2)

Education is instrumental in building personality structure and helps in charging one's behavior in social life. In the present study qualification of the head member of family has been considered(i.e. if the person complete matriculation it denoted by 10 if he/she passed higher secondary if denoted by 12, if he/she completed graduation it denoted by 15 etc.

2.8.3 Total number of the family member(X_3)

Total numbers of adult and minor member present in a family were considered for the study.

2.8.4 Total cost of energy per month(X_4)

Total cost of energy per month is an important parameter to access the economic status of a family in the society. Data was taken by dividing the cost of energy per month by family member.

2.8.5 Total household land(X_5)

Household land refers to a parcel of property jointly owned by all members of a particular family. In this study household land has been divided into two parts i.e. total covered area and green covered area. Data was taken by dividing total green area by total cover area.

2.8.6 Income(X_6)

The Monthly Income of a person is an important parameter to assess the economic status of the person in the society. In this study income has been classified into three categories i.e. service, business, and farmer and the income of the family head have been considered for the study and it is divided by family member.

2.8.7 Expenditure(X_7)

The expenses or disbursements made by a family purely for personal consumption during the reference period. Data was taken by dividing monthly expenditure by family member.

2.8.8 Total volume of waste generation from household per day(X_8)

Total amount of waste generation is an important parameter for the purpose of the study. Data was taken by dividing total volume of waste by family member.

2.8.9 Water consumption per day(X_9)

Data was collected by dividing total consumption of water per day by family member.

2.8.10 Total bio diversity(X_{10})

Biodiversity is the variety and variability of life on Earth. Biodiversity is typically a measure of variation at the genetic, species, and ecosystem level. In this study bio diversity measured the total area covered by the vegetable, flower, orchard and others. For the purpose of the study total bio diversity has divided by the family member.

2.8.11 Impact of wastes management and recycling on household(X_{11})

Data has been collected through 10 point scale. Question was asked to the respondents and they gave score out of 10 on the basis of their preferences.

2.8.12 Impact of wastes management and recycling on agriculture(X_{12})

Data has been collected through 10 point scale. Question was asked to the respondents and they gave score out of 10 on the basis of their preferences.

2.8.13 Impact of wastes management and recycling on livestock(X_{13})

Data has been collected through 10 point scale. Question was asked to the respondents and they gave score out of 10 on the basis of their preferences.

2.8.14 Impact of wastes management and recycling on water(X_{14})

Data has been collected through 10 point scale. Question was asked to the respondents and they gave score out of 10 on the basis of their preferences.

2.8.15 Impact of wastes management and recycling on soil(X_{15})

Data has been collected through 10 point scale. Question was asked to the respondents and they gave score out of 10 on the basis of their preferences.

2.8.16 Impact of wastes management and recycling on micro flora and fauna(X_{16})

Data has been collected through 10 point scale. Question was asked to the respondents and they

gave score out of 10 on the basis of their preferences.

2.8.17 Exposure to media(X_{17})

This variable has been classified in to four categories that are Radio, Television, Newspaper, Mobile phone and the ranking were done by adaptability of these media and total values has been divided by family member.

2.8.18 Training received regarding waste management(X_{18})

Training is teaching, or developing in oneself or others, any skills and knowledge or fitness that relate to specific useful competencies. Data collected on the basis of number of training received.

2.8.19 People's participation in waste recycling programmer(X_{19})

Data collected on the basis of number of people participated in waste recycling programme.

2.8.20 Perception on environmental impact of waste management(X_{20})

Four types of question were asked to the respondents and scores have been given according to their preferences.

2.8.21 Waste management at household level(X_{21})

Data has been collected on the basis of what percentage of household wastes can be utilized for compost making or for other uses.

2.9 Volume of Waste used for Different Purposes (Y_1)

Amount of non bio degradable wastes used for recycling and amount of bio degradable wastes

used for composting has been considered for the study.

3. RESULTS AND DISCUSSION

3.1 Coefficient of Correlation (r): Volume of Wastes used for Different Purposes (y_1) vs. 21 Independent Variables(x_1 - x_{21}) (Kalyani Municipal Area)

Result describes the coefficient of correlation between volume of wastes used for different purposes (y_1) and 21 independent variables (x_1 - x_{21}). The variables family member (x_3), household land (x_5), water consumption per day (x_9), impact of waste management on health(x_{11}) and perception on environmental impact of waste management (x_{20}) have gone positively and significantly to influence volume of wastes used for different purposes. The following variables education (x_2), total cost of energy (x_4), income(x_6), expenditure of family(x_7), volume of waste generation per household(x_8), impact of waste management on agriculture(x_{12}), training received (x_{18}), waste management at household level with value addition by percentage (x_{21a}) have got a negative influence on volume of wastes used for different purposes.

3.2 Multiple Regression Analysis: Volume of Waste used for Different Purposes (y_1) vs. 21 Independent Variables (x_1 - x_{21}) (Kalyani Municipal Area)

Result offers us the multiple regression analysis with full model, to see what are the significant independent variables functionally impact on independent variables. The R^2 value being 77.50 per cent, it is to conclude that with the combination of 21 variables 77.50 percent of values in the analysis have been explained.

Table 1. Coefficient of correlation (r): Volume of wastes used for different purposes (y_1) vs. 21 independent variables(x_1 - x_{21}) (kalyani municipal area)

SL No	Independent Variables	'r' Value	Remarks
1.	Age(x_1)	.017	
2.	Education(x_2)	-.771	**
3.	Family member(x_3)	.244	*
4.	Total cost of energy(x_4)	-.643	**
5.	Household land(x_5)	.563	**
6.	Income(x_6)	-.646	**
7.	Expenditure of family(x_7)	-.604	**
8.	Volume of waste generation per household(x_8)	-.604	**
9.	Water consumption per day(x_9)	.339	**
10.	Total bio diversity(x_{10})	-.218	

SL No	Independent Variables	'r' Value	Remarks
11.	Impact of waste management on health(x_{11})	.606	**
12.	Impact of waste management on agriculture(x_{12})	-.370	**
13.	Impact of waste management on livestock(x_{13})	.079	
14.	Impact of waste management on water(x_{14})	.048	
15.	Impact of waste management on soil(x_{15})	-.192	
16.	Impact of waste management on micro flora and fauna(x_{16})	-.013	
17.	Exposure to media(x_{17})	-.180	
18.	Training received(x_{18})	-.341	**
19.	Participation on waste recycling programmer (x_{19})	.154	
20.	Perception on environmental impact of waste management(x_{20})	.286	*
21.	Waste management at household level with value addition by percentage (x_{21a})	-.496	**
22.	Waste management at household level with value addition by percentage (x_{21b})	-.045	

** Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level

Table 2. Multiple regression analysis: Volume of waste used for different purposes (y_1) vs. 21 independent variables (x_1 - x_{21}) (Kalyani municipal area)

Sl.no	Variables	Reg.Coef. B	S.E. B	Beta	t Value
1.	Age (x_1)	.002	.017	.012	.124
2.	Education(x_2)	-.123	.045	-.577	-2.721
3.	Family member(x_3)	.252	.188	.230	1.340
4.	Cost of energy per month (x_4)	.000	.002	-.070	-.267
5.	Household land (x_5)	-2.140	1.714	-.251	-1.249
6.	Income (x_6)	2.947	.000	.204	.717
7.	Expenditure (x_7)	-2.251	.000	-.044	-.204
8.	Volume of waste generation from household (x_8)	.000	.001	.119	.637
9.	Water consumption per day (x_9)	.026	.035	.091	.739
10.	Total bio diversity (x_{10})	.001	.002	.236	.722
11.	Impact of waste management on Health (x_{11})	-.082	.077	-.095	-1.061
12.	Impact of waste management on Agriculture (x_{12})	.112	.075	.122	1.495
13.	Impact of waste management on Livestock(x_{13})	.100	.095	.095	1.055
14.	Impact of waste management on Water(x_{14})	-.003	.058	-.004	-.046
15.	Impact of waste management on Soil(x_{15})	.080	.076	.097	1.058
16.	Impact of waste management on Micro flora and fauna(x_{16})	-.131	.102	-.149	-1.285
17.	Exposure to Media(x_{17})	-.143	.118	-.107	-1.214
18.	Training received(x_{18})	.037	.084	.039	.447
19.	Participation on waste recycling programmer (x_{19})	.008	.124	.007	.068
20.	Perception on environmental impact of waste management(x_{20})	-.148	.101	-.143	-1.473
21.	Waste management at household level with value addition by percentage (x_{21a})	.000	.003	-.004	-.048
22.	Waste management at household level with value addition by percentage (x_{21b})	.013	.008	.186	1.704

R square: 77.50 per cent. The standard error of the estimate 57.87 per cent

Table 3. Stepwise regression analysis: Volume of waste used for different purposes (y_1) vs. 21 independent variables (Kalyani municipal area)

Sl.No	Variables	Reg.coef.B	S.E. B	Beta	t value
1.	Education(x_2)	-.118	.018	-.557	-6.421
2.	Impact of waste management on Agriculture (x_{12})	.171	.063	.187	2.722
3.	Perception on environmental impact of waste management(x_{20})	-.184	.081	-.177	-2.265
4.	Waste management at household level with value addition by percentage (x_{21b})	.019	.006	.259	3.179

R square: 69.90 per cent. The standard error of the estimate 57.60 per cent

3.3 Stepwise Regression Analysis: Volume of Waste used for Different Purposes (y_1) vs. 21 Independent Variables (Kalyani Municipal Area)

The Stepwise regression analysis suggests that five variables retained in the last step and have contributed 69.90 per cent of the total variance explained. Here, these four variables have explained approximately 90 per cent of the total variance explained.

Education contributes to ecological awareness and cleanliness. The better perception on waste management on agriculture and its impact on environmental health has got significant functional unit. Value addition to waste has been found to have decisive impact on waste management.

3.4 Path Analysis: Decomposition of Total Effect into Direct, Indirect and Residual Effect: Volume of Wastes used for Different Purposes (y_1) vs. Consequent Variables(x_1 - x_{21})

The path analysis decomposes the total effect into direct, indirect and residual effect of volume of wastes used for different purposes (y_1) vs. 21 exogenous variables. The variable Impact of waste management on Health (x_{11}) exerts the highest total effect(r), and the variable, family member(x_3) records the highest direct effect and the variable Household land (x_5) exerts the

highest indirect effect on volume of wastes used for different purposes (y_1). The variable education(x_2) has routed the highest indirect effect through as many as eight exogenous variables. The path analysis depicts that 22.47 per cent variance in volume of wastes used for different purposes (y_1) cannot be explained.

3.5 Coefficient of Correlation (r): Volume of Waste used for Different Purposes (y_1) vs. 21 Independent Variables(x_1 - x_{21}) (Jalpaiguri Municipal Area)

Result describes the coefficient of correlation between volume of wastes used for different purposes (y_1) and 21 independent variables(x_1 - x_{21}). The variables age(x_1),family member(x_3), household land(x_5),volume of waste generation per household(x_8),total bio diversity(x_{10}), impact of waste management on livestock(x_{13}),participation on waste recycling programmer (x_{19}) and waste management at household level with value addition by percentage (x_{21a}) have gone positively to influence volume of wastes used for different purposes. Similarly the change in the following variables, education(x_2), total cost of energy(x_4), income(x_6), expenditure of family(x_7),water consumption per day(x_9),exposure to media(x_{17}),perception on environmental impact of waste management(x_{20}) have got a negative impact on volume of wastes used for different purposes.

Table 4. Path analysis: Decomposition of total effect into direct, indirect and residual effect: Volume of wastes used for different purposes (y_1) vs. consequent variables(x_1 - x_{21})

Sl. No	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
1.	Age (x_1)	0.017	0.008	0.009	0.102(x_3)
2.	Education(x_2)	-0.771	-0.586	-0.185	0.198(x_6)
3.	Family member(x_3)	0.244	0.228	0.016	0.169(x_2)
4.	Cost of energy per month (x_4)	-0.643	-0.081	-0.562	0.181(x_6)
5.	Household land (x_5)	0.563	-0.244	0.807	0.378(x_2)
6.	Income (x_6)	-0.646	0.221	-0.867	0.143(x_5)
7.	Expenditure (x_7)	-0.604	-0.048	-0.556	0.197(x_6)
8.	Volume of waste generation from household (x_8)	-0.604	0.128	-0.732	0.176(x_2)
9.	Water consumption per day (x_9)	0.339	0.094	0.245	0.116(x_6)
10.	Total bio diversity (x_{10})	-0.218	0.219	-0.437	0.354(x_2)
11.	Impact of waste management on Health (x_{11})	0.606	-0.095	0.701	0.107(x_5)
12.	Impact of waste management on Agriculture (x_{12})	-0.370	0.122	-0.492	0.032(x_6)
13.	Impact of waste management on Livestock(x_{13})	0.079	0.095	-0.016	0.032(x_{12})
14.	Impact of waste management on Water(x_{14})	0.048	-0.004	0.052	0.074(x_6)
15.	Impact of waste management on Soil(x_{15})	-0.192	0.097	-0.289	0.026(x_{13})
16.	Impact of waste management on Micro flora and	-0.013	-0.149	0.136	0.056(x_{15})

Sl. No	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
	fauna(x_{16})				
17.	Exposure to Media(x_{17})	-0.180	-0.106	-0.074	0.074(x_5)
18.	Training received(x_{18})	-0.341	0.039	-0.380	0.053(x_2)
19.	Participation on waste recycling(x_{19})	0.154	0.009	0.145	0.213(x_2)
20.	Perception on environmental impact of waste management(x_{20})	0.286	-0.144	0.430	0.120(x_5)
21.	Waste management at household level with value addition by percentage (x_{21a})	-0.496	-0.004	-0.492	0.073(x_2)
22.	Waste management at household level with value addition by percentage (x_{21b})	-0.045	0.185	-0.230	0.337(x_2)
Residual effect: 22.47 per cent					

Table 5. Coefficient of correlation (r): Volume of waste used for different purposes (y_1) vs. 21 independent variables(x_1 - x_{21}) (jalpaiguri municipal area)

Sl No	Independent Variables	'r' Value	Remarks
1.	Age(x_1)	.385	**
2.	Education(x_2)	-.669	**
3.	Family member(x_3)	.509	*
4.	Total cost of energy(x_4)	-.422	**
5.	Household land(x_5)	.592	**
6.	Income(x_6)	-.551	**
7.	Expenditure of family(x_7)	-.626	**
8.	Volume of waste generation per household(x_8)	.366	**
9.	Water consumption per day(x_9)	-.259	*
10.	Total bio diversity(x_{10})	.468	**
11.	Impact of waste management on health(x_{11})	-.211	
12.	Impact of waste management on agriculture(x_{12})	.227	
13.	Impact of waste management on livestock(x_{13})	.238	*
14.	Impact of waste management on water(x_{14})	.001	
15.	Impact of waste management on soil(x_{15})	.044	
16.	Impact of waste management on micro flora and fauna(x_{16})	.094	
17.	Exposure to media(x_{17})	-.360	**
18.	Training received(x_{18})	-.007	
19.	Participation on waste recycling programmer (x_{19})	.495	**
20.	Perception on environmental impact of waste management(x_{20})	-.306	**
21.	Waste management at household level with value addition by percentage (x_{21a})	.513	**
22.	Waste management at household level with value addition by percentage (x_{21b})	-.096	

** Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level

3.6 Multiple Regression Analysis: Volume of Waste used for Different Purposes (y_1) vs. 21 Independent Variables (x_1 - x_{21})

Result offers us the multiple regression analysis with full model to see what are the significant causal variables functionally impact on consequent variables. The R^2 value being 71.70 per cent it is to conclude that with the combination of 21 variables 71.70 per cent of the variance in the analysis has been explained.

3.7 Stepwise Regression Analysis: Volume of Waste used for Different Purposes (y_1) vs. 21 Independent Variables

The Stepwise regression analysis suggests that four variables retained in the last step and has contributed 58.90 per cent of the total variance explained. Here, these four variables have explained approximately 82 per cent of the total variance explained.

Table 6. Multiple regression analysis: Volume of waste used for different purposes (y_1) vs. 21 independent variables (x_1 - x_{21})

Sl.No	Variables	Reg.Coeff. B	S.E. B	Beta	t Value
1.	Age (x_1)	-.022	.015	-.192	-1.476
2.	Education(x_2)	-.108	.059	-.308	-1.831
3.	Family member(x_3)	.201	.275	.168	.732
4.	Cost of energy per month (x_4)	.001	.001	-.039	-.348
5.	Household land (x_5)	.198	1.895	.023	.105
6.	Income (x_6)	2.767	.000	.119	.582
7.	Expenditure (x_7)	-4.308	.000	-.058	-.290
8.	Volume of waste generation from household (x_8)	.002	.001	.362	3.488
9.	Water consumption per day (x_9)	-.013	.028	-.060	-.449
10.	Total bio diversity (x_{10})	-.001	.001	-.086	-.432
11.	Impact of waste management on Health (x_{11})	-.049	.096	-.049	-.506
12.	Impact of waste management on Agriculture (x_{12})	.034	.115	.030	.298
13.	Impact of waste management on Livestock(x_{13})	.112	.099	.117	1.137
14.	Impact of waste management on Water(x_{14})	.087	.102	.085	.859
15.	Impact of waste management on Soil(x_{15})	-.205	.117	-.170	-1.756
16.	Impact of waste management on Micro flora and fauna(x_{16})	.243	.115	.230	2.103
17.	Exposure to Media(x_{17})	-.039	.176	-.022	-.224
18.	Training received(x_{18})	.153	.096	.150	1.593
19.	Participation on waste recycling programmer (x_{19})	.208	.148	.203	1.402
20.	Perception on environmental impact of waste management(x_{20})	-.567	.185	-.361	-3.062
21.	Waste management at household level with value addition by percentage (x_{21a})	.006	.004	.215	1.787
22.	Waste management at household level with value addition by percentage (x_{21b})	-.002	.005	-.034	-.374

R square: 71.70 per cent

The standard error of the estimate 76.49 per cent

Education contributes to ecological awareness and cleanliness. Household land, volume of waste generation form household and water consumption has got significant functional impact on volume of wastes used for different purposes.

3.8 Path Analysis: Decomposition of Total Effect into Direct, Indirect and Residual Effect: Volume of Wastes used for Different Purposes (y_1) Vs. Consequent Variables(x_1 - x_{21})

Path analysis decomposes the total effect into direct, indirect and residual effect of volume of

wastes used for different purposes (y_1) vs. 21 exogenous variables. The variable Household land(x_5) exerts the highest total effect (r), and the variable, volume of waste generation from household (x_8) records the highest direct effect and the variable age (x_1) exerts the highest indirect effect on volume of wastes used for different purposes (y_1). The variable Education(x_2) has enrooted the highest indirect effect through as many as eight exogenous variables. The path analysis depicts that 28.30 percent variance in volume of wastes used for different purposes (y_1) cannot be explained.

Table 7. Stepwise regression analysis: Volume of waste used for different purposes (y_1) vs. 21 independent variables

Sl.No	Variables	Reg.coef.B	S.E. B	Beta	t value
1.	Education(x_2)	-.147	.035	-.419	-4.244
2.	Household land (x_5)	1.906	.818	.225	2.332
3.	Volume of waste generation from household (x_8)	.002	.000	.332	3.573
4.	Water consumption per day (x_9)	-.044	.020	-.208	-2.174

R square: 58.90 per cent

The standard error of the estimate 79.46 per cent

Table 8. Path analysis: Decomposition of total effect into direct, indirect and residual effect: Volume of wastes used for different purposes (y₁) vs. consequent variables(x₁-x₂₁)

Sl. No	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
1.	Age (x ₁)	0.385	-0.188	0.573	0.181(x ₂)
2.	Education(x ₂)	-0.669	-0.303	-0.366	0.112(x ₁)
3.	Family member(x ₃)	0.509	0.160	0.349	0.192(x ₂)
4.	Cost of energy per month (x ₄)	-0.422	-0.039	-0.383	0.097(x ₁)
5.	Household land (x ₅)	0.592	0.029	0.563	0.173(x ₂)
6.	Income (x ₆)	-0.551	0.113	-0.664	0.076(x ₁)
7.	Expenditure (x ₇)	-0.626	-0.056	-0.570	0.105(x ₁)
8.	Volume of waste generation from household (x ₈)	0.366	0.364	0.002	0.046(x ₂)
9.	Water consumption per day (x ₉)	-0.259	-0.062	-0.197	0.152(x ₈)
10.	Total bio diversity (x ₁₀)	0.468	-0.090	0.558	0.159(x ₂)
11.	Impact of waste management on Health (x ₁₁)	-0.211	-0.048	-0.163	0.051(x ₈)
12.	Impact of waste management on Agriculture (x ₁₂)	0.227	0.029	0.198	0.091(x ₂)
13.	Impact of waste management on Livestock(x ₁₃)	0.238	0.116	0.122	0.112(x ₁₆)
14.	Impact of waste management on Water(x ₁₄)	0.001	0.086	-0.085	0.051(x ₂₀)
15.	Impact of waste management on Soil(x ₁₅)	0.044	-0.171	0.215	0.066(x ₁₆)
16.	Impact of waste management on Micro flora and fauna(x ₁₆)	0.094	0.230	-0.136	0.063(x ₈)
17.	Exposure to Media(x ₁₇)	-0.360	-0.024	-0.336	0.052(x ₁)
18.	Training received(x ₁₈)	-0.007	0.148	-0.155	0.024(x ₈)
19.	Participation on waste recycling(x ₁₉)	0.495	0.205	0.290	0.179(x ₂)
20.	Perception on environmental impact of waste management(x ₂₀)	-0.306	-0.359	0.053	0.078(x ₁₆)
21.	Waste management at household level with value addition by percentage (x _{21a})	0.513	0.215	0.298	0.170(x ₂)
22.	Waste management at household level with value addition by percentage (x _{21b})	-0.096	-0.033	-0.063	0.076(x ₈)

Residual effect: 28.30 per cent

4. SUMMARY AND CONCLUSION

The entire study has created an array of platforms to elucidate the effect of such transformation as it is happening in both kalyani and jalpaiguri municipal area and uniquely been elucidated with the following observations. The recycling and management of municipal waste has got economic, ecological and management dimensions, and jalpaiguri as well as kalyani are no exception to it. The surrounding ecology of any municipality is the primary recipient of waste generated by the life and livelihood of the citizen of respective municipalities. In case are not recycled or managed either the ecology with cease to function as a balancing and support system for the life and livelihood of any urban settlement. The huge disposal of urban wastes are offering serious threat and concern to the ecological health including human and livestock health if the waste generated are not managed or recycled. Two municipalities jalpaiguri from the northern part of Bengal and kalyani surrounded by new alluvial agro ecosystem are considered

for the study. A total of 150 respondents have been selected, 75 from each of kalyani and jalpaiguri by following cluster random sampling to frame up the total number of eligible respondents.

Throughout the undulation of the study it has been observed that in terms of variable behavior and responses there have been stark differences between jalapaiguri and kalyani municipal areas. In kalyani some few variables like perception of environmental impact on waste management, waste management at household level with value addition by percentage, impact of waste management on agriculture have recorded the distinct contribution on volume of waste used for different purposes, for jalpaiguri total household land, volume of waste generation from household, water consumption per day have gone in the determinant way so, in delineate both in kalyani and jalpaiguri municipal areas specific strategy in regard to waste recycling and management these variables must be considered.

ACKNOWLEDGEMENT

My deepest sense of respect and heartfelt gratitude to my guide Prof. Amitava Biswas, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia for suggesting the topic, ceaseless and sagacious guidance, sustained interest, valuable suggestions, ever encouraging inspiration and constructive criticisms during the course of investigation and also during the preparation of the manuscript. I express my profound gratitude to Prof. S.K.Acharya, Department of Agricultural Extension, BCKV and member of my advisory committee for his advice, supervision, and crucial contribution, which made him a backbone of my work. Thanks to my friend and year mate Mr. Dibyendu Pal, PhD research scholar, Department of Agricultural Extension, B.C.K.V for his support and contribution during the preparation of manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/59872>