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FINANCING RURAL SOLID WASTE MANAGEMENT: A REVIEW OF RESIDENTIAL PARTICIPATION IN KONAJE GRAM PANCHAYAT, INDIA

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Abstract
Many factors impede the prevalence of healthy practices in the rural areas, rendering these areas to lag behind compared to urban areas. Introduction of sustainable practices in ensuring waste is properly managed may bring a breakthrough, among this availability of funds for waste management practices is more than essential. Waste generator's contribution in financing proves to be sustainable than depending on any other stakeholders in waste management. A binary probit model was employed to scrutinize the residential willingness to pay for waste collection services. The study finds that burning of waste materials was highly preferred by the rural residents, more than reuse, recycle and dispose. Residents who have a high level of education, higher income, perceive waste situation to be very good, commend waste have harmful effect on human health, assume to play important role in waste management, satisfied with waste management system and attend in waste management programme are likely to be willing to pay for waste collection services. Financing rural solid waste management practices should be contributed not only by indirect stakeholders but also the participants in waste generation with supporting grounds that makes them feel responsible in waste management, this can be through pricing of recyclable waste, installing a rural residential appreciated system of waste management, encouraging and formalizing cooperative rural residential participation.

Key words: Waste management, rural waste, sustainable practice.
***Paper type**: Research paper*
***Type of Review:** Peer Review*

1. INTRODUCTION

Majority of rural areas are left behind in many sustainable efforts and practices and are given less concern in many circumstances. Various aspects that contribute these susceptible situations in rural areas compared to urban areas. Such aspects include low literacy rates, poor economic condition, lack of profound political representation, irresponsible leadership, and poor economic background among others… unfold and manifest in rural areas (Gao, *et al,* 2012). These have rendered rural areas in terms of waste management turned into waste dumping grounds for most of urban population. Waste is either unwanted materials, items of no use or those that have ended their useful life (Addai & Danso, 2014; Furedy & Lardinios, 2000) which reveals the need for waste management in the rural areas. Financing the

management of generated waste is intrinsic to the collection of waste (Couth & Trois, 2010), however rural areas in many studies affirm that financing towards waste management lags behind (Boadi & Kuitunen, 2004). This is due to the fact that population is widely scatted and the immediate consequences of poor waste management practices cannot be evidenced. Majority of illiterate live in the rural areas earning low income, governments put much efforts in monitoring areas highly concentrated with economic activities (urban), rural areas reveal insufficient management facilities (Seth, *et al*, 2014). However, depending on government financing is deemed to be less effective and not adequately sustainable, it requires residential participation in management of waste (Seth, *et al*, 2014).

Waste generated in the rural areas mainly includes agriculture waste, animal dung, drain, dead plants and animals, street cleanings (Shah & Tiwari, 2012; Rahji, & Oloruntoba, 2009), however it may also be found that nonbiodegradable waste also exists. Apart from generated waste some of the rural areas have been turned into dumping sites for waste generated in urban areas, this increase the amount of waste that is found in the rural areas, intensifying the need for efficient management of waste. Readiness to pay for waste management services has in many studies revealed to be influenced by resident's income (Addai & Danso, 2014) which should be also considered in terms of allocation and control of cash resources (Adebo & Ajewole, 2012). In India the waste management practice of village panchayat is governed by waste management rules under which the 15th rule of solid waste management of 2016 stipulates the duties and responsibilities of village gram panchayat among which include: planning the waste management practice as per state policy and strategy, as per waste management rules frame, the by-laws of cooperation, waste collection and segregation, establish waste deposit centres/waste recovery facilities, management of old and existing dumpsites, conduction of training and awareness in waste management, ensuring sustainable waste management practices.

Proper planning and arrangement of waste management activities can be effectively done by first having not only the right information but also accurate information (Shah & Tiwari, 2012). Rural waste management is geared to ensure that waste materials are properly collected, reusable being recovered for recycling, biodegradable waste turned to compost and remnant waste properly disposed. This assures: less environmental hazards, less negative waste consequences and improvement in the living conditions in the rural areas. In view of other studies on the determinants of residential willingness to participate in financing waste management activities have revealed the influence of a resident's age, income, level of education, health effects of waste generated, size of waste generated and quality of service (Alta & Deshaz, 1996). Many studies have been conducted in urban areas and little is available in rural and semi-rural areas. Numerous studies have been conducted on financing municipal and semi-rural India while very few are available on financing rural waste management practices. This study was attempted to describe rural waste management practices, analyze the residential willingness to participate in financing waste management practices and suggest strategies for funding rural waste management practices in rural India.

2. MATERIALS AND METHODS

2.1 Study Area

Konaje Gram Panchayat is located in Mangalore Taluka in Dakshina Kannada district of the state of Karnataka in India, was purposely selected due to it being an educational hub and for convenience. In most cases economic activities form the focal point for waste generation among all human activities, there are many economic activities that are taking place in Mangalore taluka such as shipping services, refinery factories, manufacturing industries, information technology, food processing, banking, insurance, fishing and tourism centres. The total waste generated per day amounts to 220 tons according to data recorded in

2013, daily collected waste out of the total generated per day is 210 tons. Konaje gram panchayat has a population of 11368 (2011 Census report) living in eleven wards.

2.2 Sampling design

Using the formula given by Krejcie and Morgan below a total of 320 respondents from Konaje Gram Panchayat were randomly selected in three clusters households, businesses and education centres.

$$n = \frac{X^2 NP\ (1-P)}{d^2(N-1)\ + X^2 P(1-P)}$$

Where; X^2 is the table value of Chi square for 1 degree of freedom at a certain confidence level. N represents the known population, P is the population proportion assumed to be 0.5 since this would provide maximum sample size, d is the degree of accuracy expressed as a proportion of margin error, and n is the sample size. For calculations the study took a confidence level of 95% and a margin error of 5.4%, resulting to 320 sample respondents. As literature recommends on the reliability of face to face method of collecting primary data (Arrow *et al*, 1993) likewise questionnaires were served to each of the respondents, and questions explained in a hypothetical scheme to minimize strategic bias. Responses that were well-founded were analyzed using statistical software STATA.

2.3 Procedures

In analyzing the objectives, the study used both secondary and primary data, were secondary involved review of waste management rules, published articles and books., to collect primary data a questionnaire was employed, a range of questions were asked to discern the waste management situation and the financing behavior of the rural residents of Konaje gram Panchayat, their willingness to pay for waste management services and a range of other factors. The study collected data on the willingness to pay for waste collection services, information on handling of waste, how waste is being disposed, perception on waste disposal, satisfaction with waste collection services, information on health effects of improper waste management and other demographic characteristics such as age, sex, education, religion, income level, marital status and size of the family. Coding was done to analyze willingness to pay were responses with "yes" were recoded as 1 and 0 otherwise, and given a dichotomous response a binary Probit model was used as the empirical model of estimation. Probit regression was preceded with the Goodman and Kruskal's Gamma to determine if a relationship existed between the willingness of the residents to pay for waste collection services and the various selected categorical independent variables.

The form of a Probit model let the utility index Y represent the wiliness to pay for waste management services, the estimated Probit model is specified as $Prob(Y = 1|X) = f(\beta_i X_i) + \grave{e}$, where X_i represents the explanatory variables, β_i represents the coefficient of explanatory variables. The estimated equation for residential willingness to pay for waste management services in Konaje Gram Panchayat is given by the following equation:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots\cdots\cdots + \beta_{10} X_{10} + \grave{e}$$

Table 1: Description of independent variables of willingness to pay for waste management services

No.	Variable	Interpretation	Measurement
1	X_1	Age (in years)	<20 = 1, 20-29 = 2, 30-39 = 3, 40-49 = 4 50-59 = 5, >60 = 6
2	X_2	Gender	Male = 1, Female = 0
3	X_3	Education level	No School = 1, Basic = 2, Secondary = 3, Tertiary = 4
4	X_4	Average Monthly Income (in Rupees)	<1000 = 1, 1000-5000 = 2 5000-10000 = 3, > 10,000 = 4
5	X_5	Perception on Waste situation	Very poor = 1, Poor=2, Fair=3, Good=4, Very good=5
6	X_6	Receiving information on waste management	Never = 1, Seldom = 2, Sometimes = 3, Often = 4, Almost always = 5
7	X_7	Perception of harmfulness of waste materials on human health.	Harmful = 1, Not Harmful = 0
8	X_8	Perceived role played in waste management	Not Important = 1, Moderate Important = 2 Very Important =3
9	X_9	Satisfaction with waste management system	Not satisfied = 1, Moderately satisfied = 2 Extremely satisfied = 3
10	X_{10}	Attendance to program concerning waste management	Never = 1, Rarely = 2, Sometimes = 3 Often = 4, Always = 5

3. RESULTS AND DISCUSSION

3.1 Social and economic characteristics of the respondents

Table 2 shows the age of the respondents who are below 20 years are 31 of which from the total male and female respondents are 12.4% and 6.7% respectively, those between 20-29 years are 69 in both male and female, while in terms of percentage that of female have 6.6% higher percentage compared to male respondents. Those between 40-49 male are 22 while female respondents are 21. Only 3.5% of the total male respondents are above 60 years while female is 2% of their total respondents.

Those who have received no schooling majority are female compared to male, however 56% of the female respondents have undertaken tertiary education while male respondents amount to 38% of their total. Marital status of the male respondents shows 44.7% are single, 52.4% married, 1.2% divorced and widowed 1.8% while female respondents are 40%, 56%, 0.7% and 3.3% respectively. Majority of the respondents indicated to have a family size of 3 to 5 members, of the total male respondents indicate 62.4% and 65% of the total female respondents. 15.3% of the male respondents had income below Rs 1000, 15.9% had income between Rs1000 and Rs 5000, income group between Rs 5000 & Rs 10000 where 29.4%, while those above Rs 10000 are 39.4%. Female income in the selected income groups have majority with income above Rs 10000 about 33% and those below Rs 1000 are 11%, those in between Rs 5000 and Rs 10000 are 31% and those between Rs 1000 -Rs 5000 are 25%. This shows that majority of the respondents

are youth, and majority have income above Rs 5000 and of Hindu religion. However, as the lager population are expected to have basic knowledge on waste management due to their level of education.

Table 2: Social and economic characteristics of the respondents

		Male		Female	
	Variable	**Frequency (170)**	**Percentage**	**Frequency (150)**	**Percentage**
Age	<20	21	12.40%	10	6.70%
	20-29	69	40.60%	69	46%
	30-39	35	20.60%	37	24.70%
	40-49	22	12.90%	21	14%
	50-59	17	10%	10	6.70%
	>60	6	3.50%	3	2%
Education	No School	7	4.10%	9	6%
	Basic	23	13.50%	24	16%
	Secondary	75	44%	33	22%
	Tertiary	65	38%	84	56%
Marital	Single	76	44.70%	60	40%
	Married	89	52.40%	84	56%
	Divorced	2	1.20%	1	0.70%
	Widowed	3	1.80%	5	3.30%
Religion	Hindu	103	60.60%	108	72%
	Muslim	53	31.20%	27	18%
	Christian	11	6.50%	13	9%
	Other	3	1.50%	2	1%
Family size	<3	23	13.50%	17	11%
	3-5	106	62.40%	98	65%
	> 5	41	24.10%	35	23%
Average Monthly Income	<1000	26	15.30%	17	11%
	1000-5000	27	15.90%	38	25%
	5000-10000	50	29.40%	46	31%
	>10000	67	39.40%	49	32.70%

3.2 Rural waste management practices

To understand waste management practices in Konaje Gram Panchayat the residents were asked to respond to some close ended questions that reflect the existing practices. It was observed during field survey burning of waste in front of homes, on the roadsides and in open areas of the surveyed area with and respondents' statistical responses revealed a preference of 39% of the respondents to the practice as in Chart 1. Recycling was observed being practiced in homes which mainly comprised of food leftovers and peels from cooked food stuffs that were left to decompose in garden trees, flower vessels and farms, respondents indicated only 24% of them preferred recycling of waste materials.

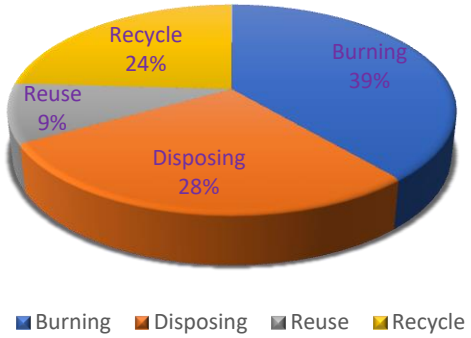

Chart 1: Most preferred waste management practice

Only 9% of the respondents preferred reusing the waste materials which is a very low number, possible causes to this is in rural areas majority of the residents are poor and reusable are totally used before being considered as waste, also their main purchases are for consumption purposes, considering carry bags majority of the food vendors, mini markets do not tag price for carry bag on purchase of few items thus reusing of the plastic carry bags is not preferred due to the fact that its freely provided. Waste burning as one of the environmental unfriendly practice found to be preferred by majority of the rural residents of Konaje Gram Panchayat despite the prevailing rules that prohibit the waste burning practice, local government authorities should enforce and create awareness to the residents on more sustainable practices as there is a high possibility of an existing residential waste management rule awareness and practice divide.

Table 3: How do you dispose waste material?

Disposing Method	Frequency	Percent
Open dump	21	6.6%
Central container	164	51.3%
Home collection	116	36.3%
Roadside collector	10	3.1%
Other	9	2.8%

51.3% of the respondents dispose their waste materials in central container, those who depend on home collection services amounts to 36.3%, 6.6% open dumping, 3.1% roadside collector and 2.8% depend on other means. Free plastic carry bags from the mini markets, food vendors and other sellers form one of the major problems in scatter of plastic carry bags on the streets, road side and open places. Having bylaws that allows supply of biodegradable carry bags only or charging a favorable price to use of plastic bags will reduce scatter of nonbiodegradable plastic and encourage reuse of the plastic carry bags respectively. The absence and unawareness of official dump sites free majority of the rural residents from showing concern on individual initiated waste management practice, since having an official dumpsite revives individual consciousness and effort to proper dumping of waste, practice of rural residential waste burning is invigorated with absence of dump sites for few amounts of wastes, but with huge amount of waste absence of official dumpsites open rural dumping is vitalized.

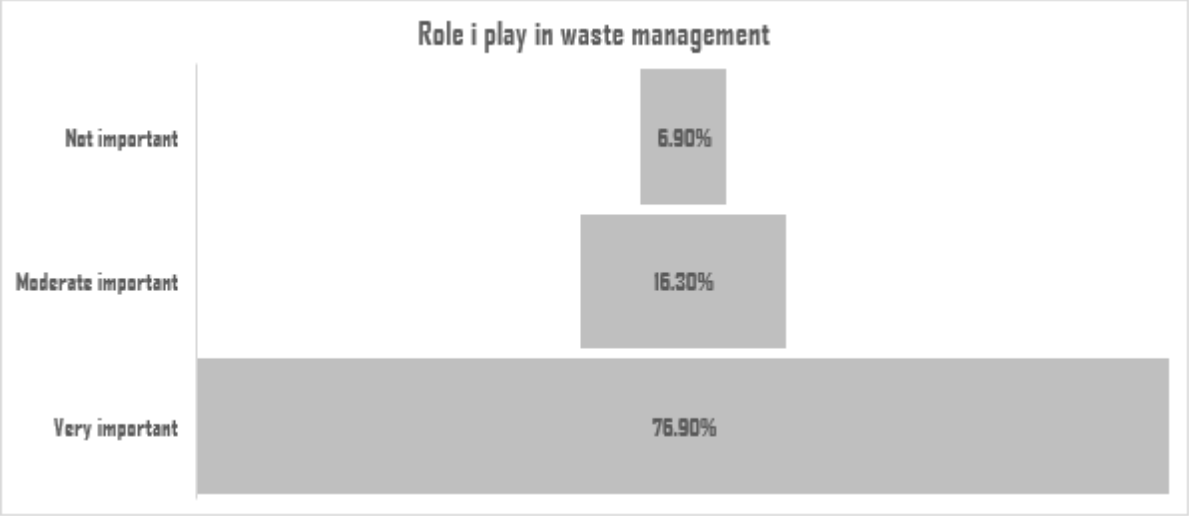

Figure 2: Perception on role played by residents in waste management practice

The residents were also asked to state how they perceived their role in waste management activities and 76.9% responded that they played a very important role and only 6.9% remarked to play no any important role in waste management as evident in chart 2. can be understood that with majority of the respondents having secondary education or above 80.3% (Table 2) they highly understand the role they play in waste management; thus, level of education significantly correlates with perception on role played in waste management at 5% level of significance. It was also observed during the survey period scattered plastic bags and other waste materials disposed on roadside and on open areas, despite the local governments necessary efforts to perform the waste collection services, private waste collectors and residential cooperative collection efforts still the situation needs introduction and strengthening of more sustainable practices, as per the waste hierarchy.

3.3 Residential willingness to pay for waste collection services

To capture the residential willingness to pay for waste collection services, respondents had to respond if they are willing to pay for waste collection services and answer Yes or No. The result indicates that 77.2% were willing to pay for waste collection services while the rest 22.8% were not willing to pay for waste collection services. Before the Probit regression the study employed Goodman and Kruskal's Gamma to find out if a significant relationship exists between the resident's willingness to pay and the selected independent variables. As displayed in Table 4, a significant relationship was found between the residential willingness to pay and education level, income, perceived waste situation, perceived residents role played in waste management, satisfaction in waste management system and attendance to waste management program.

Table 4 reveals that 39.1%, 26.9% of the residents with tertiary and secondary level of education respectively are willing to pay for waste collection services while the rest level 8.44% basic and 2.8% those attended no school. Income below Rs 1000 7.81%, income level between Rs 1000-Rs 5000 12.8%, between Rs 5000-10000 24.1% and those above Rs 10000 32.5% are willing to pay. Those who perceive waste situation to be very good, good, fair, poor, very poor respectively only 6.25%, 26.9%, 31.6%, 9.4% and 3.13% are willing to pay for waste collection services. Those who stated that waste material has impact on human health 71.9% are willing to pay for waste collection services and those stating waste material to have no health impact 5.31% are also willing to pay.

Those who perceived to play a very important role in waste management 63.13% are willing to pay while those who perceived their role to be moderate and not important 48.4%, 11.3% respectively are willing to pay. Satisfaction on the waste management system was also considered where those who are willing to pay 17.5% stated to be extremely satisfied, 48.4% moderately satisfied and 11.3% not satisfied. Attendance to programmes related with waste management those who often attend only 5.3% are willing to pay while those who attend sometimes, rarely and never 12.5%, 26.6%, and 32.8% respectively are willing to pay for waste collection services.

3.4 Probit Model regression results

Table 5 reveals that those with higher level of education are 6% more likely to pay for waste collection services, thus a higher level of education increases their probability of willingness to pay for waste collection services significantly, confirms other studies such as (Addai *et al* 2014, Boateng *et al* 2016) and others (Trang *et al* 2017). Residence with an average higher monthly income are 11% more probable to be willing to pay for waste collection services, which are not surprising results as similar results were obtained in other studies (Awunyo, Ishak & Seidu, 2013). The majority of rural areas residents of rural areas have poor economic status, what remains of their income after basic expenses they will be willing to pay for waste collection services as this amount increase.

The residents who perceive waste situation to be very good are 10% probable willing to pay for waste collection services. This reveals the need to obtain the real value of money (Boateng *et al* 2016), equivalent results have also been obtained earlier (Afroz, *et al.,* 2009) and others (Kassim & Ali, 2006). Table 5 also reveals that residents who frequently receive information on waste management are 3% not likely to be willing to pay for waste collection services, it may be presumed that as people received information may consider waste management to be government's responsibility. This can also be argued on the ground that as in many areas scattering of plastic bags was observed in many areas, a view that its local governments concern, misinterpretation of information received can also cause unwillingness to pay, such as government funds budgeted for waste management services.

Table 5: Probit regression on selected factors influencing residential willingness to pay for waste collection services in Konaje Gram Panchayat

Variable	Average Marginal Effects (dy/dx)	Standard Error
Age (in years)	-0.0074588	0.01981
Gender	-0.0048047	0.0464
Education level	0.0643189**	0.02735
Average Monthly Income (in Rupees)	0.1060854*	0.02283
Perception on Waste situation	0.1039416*	0.02517
Receiving information on waste management	-0.0329178**	0.01677
Perception of harmfulness of waste materials on human health.	0.1995902**	0.10059
Perceived role played in waste management	0.0867589**	0.03689
Satisfaction with waste management system	0.1135702*	0.03898
Attendance to programme concerning waste	0.0458477***	0.02609

management
Number of observations = 320
Prob > chi2 = 0.0000
LR chi2(10) = 89.49

*Source: Authors own computation from survey data 2019, * means P-value<0.01, ** P-value<0.05, & *** P-value<0.1*

Different from other studies (Boateng *et al*, 2016) results this study found out that those who perceive waste materials to be harmful are 20% likely to pay for waste collection services, reveals residential willingness to combat unhealth effects arising from waste accumulation. Residents who assume a more important role in waste management are 9% more likely to be willing to pay for waste collection services, thus when residents are involved in various waste management efforts will enable a higher possibility of considering their role to be more important and thus participate in financing activities. Residents who are highly satisfied with waste management system are 11% more probable to be willing to pay for waste collection services, unsatisfactory practices of waste management negatively influence this willingness. Also, residents who attend to waste management program are 5% likely to pay for waste collection services, as programs create residential awareness and reveals how important their participation in waste management practices is, thus probability of being willing to pay for waste collection services is increased.

Rural residents are willing to participate in financing waste management practices however factors such as income, prevailing waste situation, residential involvement and their satisfaction on the prevailing situation. Efforts that are taken by the government with little/no involvement of the residents in such efforts slacken residential willingness to participate. Further studies can be conducted to investigate the extent of rural awareness on waste management rules and policies, sustainable practices for enforcing rural waste management policies and financing rural solid waste through their economic potentials.

4. CONCLUSION

The study's findings may be concluded that financing waste management practices should be viewed through many angles, not only depending on government funding but also creating environment that will necessitate residential participation in willingness to pay for service or directly engaging in waste management activities. These environments cover residential involvement, pricing of recyclable waste that employ waste pickers, installing a rural residential appreciated system of waste management, encouraging and formalizing cooperative rural residential participation. Financing rural waste should not and never be disregarded, healthy rural environment assures adequate supply of the fruits of nature to the population in terms of agriculture produce, favourable rainfall, unpolluted air and not only a less contaminable surrounding to the rural population but also low/no cost incurred in curing diseases caused by mismanagement of rural waste. Sustainable waste management practices will holistically be attained by comprehensive involvement and participation by stakeholders, and retaining an atmosphere that creates a feeling of responsibility by each rural resident.

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Table 4: Goodman and Kruskal's Gamma of residential willingness to pay for waste collection services

Variable name	Willingness to pay (%) No	Yes	Gamma	ASE
Age				
<20	3.75	5.94		
20-29	7.19	35.94		
30-39	4.38	18.13	-0.055	0.104
40-49	4.38	9.06		
50-59	2.19	6.25		
>60	0.94	1.88		
Gender				
Male	12.5	40.63	-0.043	0.133
Female	10.31	36.56		
Education				
No School	2.19	2.81		
Basic	6.25	8.44	0.378***	0.096
Secondary	6.88	26.88		
Tertiary	7.50	39.06		
Income				
<1000	5.63	7.81		
1000-5000	7.50	12.81	0.486***	0.079
5000-10000	5.94	24.06		
>10000	3.75	32.5		
What is the waste situation in your locality				
Very poor	3.44	3.13		
Poor	6.25	9.38		
Fair	8.13	31.56	0.455***	0.088
Good	4.38	26.88		
Very good	0.63	6.25		
Do you get information on waste handling?				
Never	5.00	12.81		
Seldom	1.56	3.44		
Sometimes	7.81	31.25	0.078	0.106
Often	0.94	3.75		
Almost always	7.50	25.94		
Waste material have impact on human health				
Harmful	18.13	71.88		
Not Harmful	4.69	5.31	0.555**	0.133
Role I play in waste management				
Not Important	4.38	2.50	0.504***	0.102

Moderate Important	4.69	11.56		
Very Important	13.75	63.13		
Are you satisfied with waste management system in your locality				
Not satisfied	7.50	11.25		
Moderately satisfied	12.81	48.44	0.42***	0.106
Extremely satisfied	2.50	17.50		
Have you attended any program concerning waste management?				
Never	13.13	32.81		
Rarely	6.25	26.56	0.254**	0.109
Sometimes	2.50	12.50		
Often	0.94	5.31		

***, ** shows significance levels of 1% and 5% respectively