The Impact of Waste Disposal Methods on Water Quality in Siddharthnagar, Nepal

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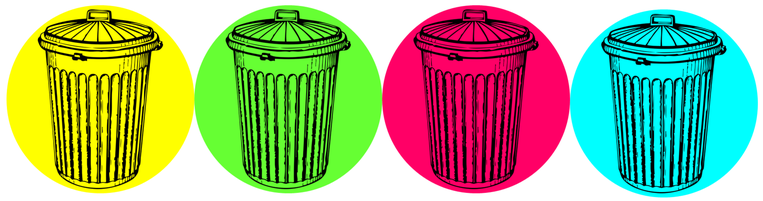
Prepared for Dr. Alok K. Bohara. This project was conducted in partial fulfillment of the research component for Fall 2017 Economics 395/595, Problem-based Learning: Urban Health and Environment (Department of Economics at UNM)



INTRODUCTION

Solid waste management in Nepal has been a challenge throughout the past several decades. With population increase comes the production of more solid waste, and the issue of managing it- especially in dense, urbanized areas. Traditionally, solid waste management in Nepal has been dominated by open dumps in abandoned fields as well as on the banks of rivers and streams. Such dumping practices lead to poor water quality, ecological destruction, and water borne illnesses. Understanding the linkages between waste disposal methods and environmental health is essential to devising solid waste management strategies that are affordable and effective.

ABSTRACT

Our objective is to analyze the relationship between waste disposal methods and water quality in Siddharthnagar, Nepal. Using data collected from surveys in Siddharthnagar, Nepal, we have tested the association between waste disposal methods and water quality.

LITERATURE REVIEW

The article “Municipal solid waste management in Nepal: practices and challenges” by D. Pokhrel and T. Viraraghavan, analyzes the environmental impacts of illegal dumping of solid waste in the Kathmandu valley of Nepal, as well as potential solutions to address this issue. According to the paper, the reasons for poor management of solid waste in the region of study are attributed to “poor institutional experience, lack of strong legislation and enforcement, and poor financial status of both government and municipalities.”

RESEARCH QUESTION

How do waste disposal methods in Siddharthnagar, Nepal contribute to water quality?

DATA VARIABLES

The *water quality index* (*WQI*) was created using the Arithmetic Index method. We used 8 water quality variables in order to create this index: Ammonia, PH, Dissolved Oxygen, Phosphate, Nitrate, Arsenic, Coliform and Fecal Coliform. These water quality components were multiplied by a weighting factor and then aggregated using the arithmetic mean, in order to get a value for WQI.

WasteDanda: Solid waste disposed in Danda River

WasteRoadside: Solid waste left at roadside to be collected by municipalities

HhWasteRiver: Household waste includes water waste disposed into the Danda River

DistanceToDanda: How far in minutes the household is away from the Danda River

HYPOTHESIS

Poor waste disposal methods contribute to poor water quality.

METHODOLOGY

Multivariable Regression and Coefficient Testing

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_{k+} \varepsilon$$

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

$$H_a: at\ least\ one\ slope \neq 0$$

$$F^* = \frac{R^2/(k-1)}{(1-R^2)/(n-k)}$$

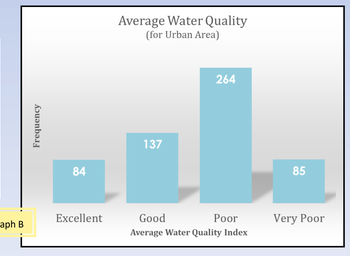
Goodness of Fit Measure and Comparison

$$\overline{R^2} = 1 - \frac{\frac{RSS}{n-k}}{\frac{TSS}{n-1}} = 1 - \frac{\sum_{i=1}^{n} \hat{u}^2/(n-k)}{\sum_{i=1}^{n} (\hat{y} - \bar{y})^2/(n-1)}$$

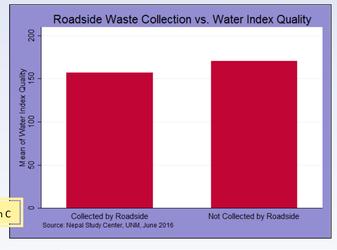
MODELS

Water Quality Index Level	Description
<50	Excellent
50-100	Good
100-200	Poor
>200	Very Poor

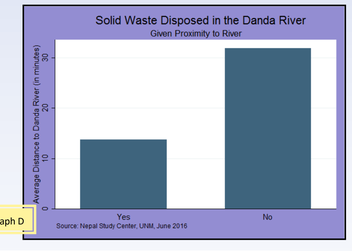
Graph A



Graph B



Graph C



Graph D

Source	SS	df	MS		
Model	5122933.1	6	853822.184	Number of obs	= 745
				F(6, 738)	= 60.45
Residual	10424078.4	738	14124.7675	Prob > F	= 0.0000
				R-squared	= 0.3295
				Adj R-squared	= 0.3241
Total	15547011.5	744	20896.5209	Root MSE	= 118.85

waterqindex	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
WasteDanda	26.27429	13.63072	1.93	0.054	-.4853182	53.0339
WasteRoadside	-40.15311	10.40629	-3.86	0.000	-60.58256	-19.72366
HhWasteRiver	-2.70537	11.12216	-0.24	0.808	-24.54021	19.12947
DistanceToDand~n	-10.20826	3.119422	-3.27	0.001	-16.33226	-4.08426
Location						
[2] Basantapur	-209.1072	15.32378	-13.65	0.000	-239.1906	-179.0238
[3] Bagaha	-203.7716	15.12202	-13.48	0.000	-233.4589	-174.0843
_cons	292.6507	12.32502	23.74	0.000	268.4545	316.847

Graph E

VARIABLES	Model 1	Model 2	Model 3	Model 4
WasteDanda	39.271***	35.065***	35.049***	26.274*
	(13.259)	(13.170)	(13.178)	(13.631)
WasteRoadside		-41.350***	-41.542***	-40.153***
		(10.359)	(10.397)	(10.406)
HhWasteRiver			-2.648	-2.705
			(11.133)	(11.122)
DistanceToDandaMin				-10.208***
				(3.119)
2.Location	-184.386***	-209.952***	-209.603***	-209.107***
	(13.922)	(15.200)	(15.280)	(15.324)
3.Location	-177.477***	-204.288***	-204.218***	-203.772***
	(13.741)	(15.172)	(15.185)	(15.122)
Constant	237.709***	264.612***	265.182***	292.651***
	(5.447)	(8.632)	(8.964)	(12.325)
Observations	748	748	748	745
R-squared	0.305	0.319	0.319	0.330
R-Squared2	0.305	0.319	0.319	0.330
Adjusted-R2	0.302	0.316	0.315	0.324
F-Sat	108.7	87.12	69.62	60.45
n	748	748	748	745

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Graph F

EMPIRICAL RESULTS

The population that throws away waste into the Danda River tend to live within fifteen minutes from the river on average (graph D). The adjusted R-squared value for model 1 is 0.302. With the addition of the other variables in model 4, the adjusted R-squared value increases to 0.324. Based on the values of adjusted R-squared, model 4 is the best model (graph F). The value of F-critical for 5% level of significance with degree of freedom 6 and 738 is 2.11. The value of F-calculated is 60.45 (graph E). Since F-calculated is greater than F-critical, this means that at least one slope coefficient is not equal to zero.

CONCLUSION

We conclude that there is an association between solid waste disposal methods and water quality. The article from literature review, “Municipal solid waste management in Nepal: practices and challenges” by D. Pokhrel and T. Viraraghavan offers the following solutions: composting, since ~70% of the total solid waste is composed of organic material; education to advocate for the separation of recyclable materials in order to lower waste treatment costs; involvement of the private sector in waste management to develop a public understanding of the investment of solid waste management; and finally, more strict regulations to prevent the illegal dumping of solid waste. These solutions should be looked at as a means to improve solid waste management in Siddharthanagar, Nepal.

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