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## **Benefit Estimation of Water Quality Improvements in Bagmati River Using Choice Modeling**

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University of New Mexico

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# Benefit Estimation of Water Quality Improvement in Bagmati River Using Choice Modeling

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University of New Mexico

## Introduction

### The holy river

Flows through the heart of the Kathmandu Valley

### Highly-polluted

Solid waste and sewage, water is black and emanates a foul odor, no aquatic animals

### Impacts

The surrounding environment, cultural and religious activities and, health of local residents

### Consequences

Devaluation of property value, destruction of aesthetic values, adverse health impacts, ground-water aquifer contamination, and endangered livelihoods for farmers

### Use and non use values

Agricultural, tourism, aesthetic, cultural, and religious

### Significant welfare loss due to pollution

Benefit has rarely been investigated

### Government initiation of restoration program

Bagmati Action Plant (2009-2014)

## Motivation

### National Wetland Policy 2003

Conserve and manage wetland resources wisely in a sustainable way with local participation

### Bagmati Action Plan 2009-2014

Comprehensive and integrated BAP  
Proposal for generating funds  
Intangible heritage linked with the river  
9214 million for 2009-2014

### Estimating benefit and understanding preference

Vital for the implementation of restoration program

## Objectives

Assessing public preferences and estimating benefits of improving quality of water in the river

- preferences on attributes of river health
- impact of location of HH on WTP
- impact of being close to the river on WTP
- the appropriate revenue-collection mechanism
- preference on the management mechanism
- impact of religious and cultural factors on WTP
- impact of knowledge/awareness on WTP

## Methodology

### Focus Group Discussions and Pretest

Discussion with Key Informants-Government official, Planners, NGOs, INGOs  
3 Focus Group Discussion-Upstream, Midstream, downstream  
Pretest - 40 households

### In-person interview

Kathmandu, Lalitpur, Bhaktapur, Kirtipur, and Madhyapur Thimi  
1200 households  
40 Cluster, 30 households

### Choice Experiments

Main effect orthogonal design  
18 choice set  
6 blocks  
3 choice set to each respondents  
3 alternatives in each choice set

### An Example of Choice Set

Attributes	Alternative A	Alternative B	Alternative C- Current situation
Water quality	Walkable on the riverbank	Walkable on the riverbank, suitable for fish and plants and, suitable for swimming and bathing	Water is black, emits a foul odor, and is not suitable for fish and other aquatic animals. Contact with water is dangerous to human health.
Riverside tree plantation	40 percentage	80 percentage	20 percentage
Who is in charge of managing funding?	Municipality	Government	Not applicable
My annual payment for 5 years	Rs 3000 per year	Rs 600 per year	Rs 0 per year
Time Contribution per year	10 days	15 days	0 days

### Model Estimation

The Conditional Logit Model

$$LogL = \sum_{i=1}^n \sum_{j=1}^J d_{ij} \cdot Log Pr_{ij}(y_i)$$

### Willingness to Pay

$$MWTP = -\frac{\beta_j}{\beta_c}$$

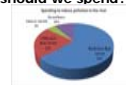
## Results and Discussion

### Descriptive statistics

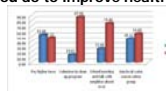
Age (>=18)	35.69
Monthly income (Rs/ per households )	19968
Education	11.95
Sex (% of male)	63.8
Family Size	5.71

### Preferences

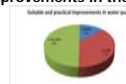
How much should we spend?



What can you do to improve health of the river?



Suitable improvements in the quality of water



Who should manage the clean up project?



### Regression Results

Variables	coefficients	Significance
ASC1	-0.0747	
W_QALITY2	0.4970	***
W_QALITY3	0.4563	***
PLANTATION	-0.0003	
M_MUNICIPALITY	0.0313	
M_COMMUNITY	0.2246	***
PAY	-0.3206	***
WTC	0.1074	*
INC	-0.0014	
SOME_COLLEGE	0.1577	*
COLLEGE	-0.0008	
Signif. codes: 0.01 '***' 0.05 '**' 0.1 '*'		

### Willingness to Pay

Quality of Water	WTP (NRS)
W_QALITY2 (Suitable for fish, aquatic plants)	1550
W_QALITY3 (Suitable for swimming)	1424
Confidence Interval (WQ2)	(1.1801 - 1.9954)

## Conclusion

### Positive WTP for improvement

Kathmanduites are willing to pay

### No status quo

Strong preference for improvements

### Preference on management

Community preferred over municipal and government

### Tree plantation

Not so important

### Socioeconomics

Income effect - not significant

Education and knowledge- some colleges

Distance and spatial- not significant

There is significant loss of welfare to the society because of degradation of health of the river. Residents are willing to contribute their time and money for the improvement of quality of water in the river.

## Policy Implications

### Welfare estimates and attributes tradeoff

Ministry, Municipal Authority

### CBA for long-term river management

Wastewater treatment, riverside park

### Preference over payment and fund management

Fund generation and management

### Participatory Management, Social Network

Sustainable management of river

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## For further information

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