Economics of urban drainage system: A case study of Cuttack city, Orissa, India[4]

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This research study explores the economic value of a well-functioning drainage system in an urban center of India. The urban drainage system regulates the environment and through it the health of the people. It promotes the urban economy.

A poor drainage system contributes to the ill-fare of the people by way of health hazards, stinking, water-logging, bad landscape, urban flooding that endangers lives and property, disrupts communication, leads to stagnation and pollution of water, adverse effects on aquatic habitats, soil erosion, silting, solid-waste blockade and migration, so on and so forth. The urban runoff mixes up with sewage from overflowing latrines and sewers and gives rise to a wide range of problems associated with water borne diseases. Flooded septic tanks and leach pits provide breeding sight for mosquitoes, and fecally contaminated wet soils provide ideal conditions for the spread of intestinal worm infections. Infiltration of polluted water into low pressure water distribution system contaminates drinking water supplies causing outbreak of diarrhea and other gastro-intestinal ailments. To this is added the poor solid waste management, lack of sufficient resources, equipment and know-how with the municipal agencies for drain cleaning. Particularly in the ancient cities, the modern techniques for improved designing in the urban hydrological cycle are not forthcoming to replace and rectify the inherent bottlenecks. Hence, the thrust is on providing a welfare oriented sustainable urban drainage system and better environment planning. However, the local urban government may not have the where-withal to meet the requirement. Thus for initiating a positive policy in this regard how much are the people willing to pay for better drainage system needs to be assessed.

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We use a hedonic property price function to estimate the effects of water-logging due to poor drainage system on property value. Hedonic price models have enjoyed wide spread use in determining the implicit value of different aspects of products since their introduction by Court (1939) and their theoretical explication by Rosen (1974). After that many studies have applied the hedonic property price models to estimate the value of environmental amenities such as the effects of proximity to schools, air quality, crime-rates, racial mix, access to jobs, earthquake zones, and floods on the selling prices of real properties (Brookshire et al. 1985, Dubin and Goodman 1982, Evans and Beed 1986, Freeman 1979, Harrison and Rubinfeld 1974, Li and Brown 1980, Palmquest 1984, Ridler and Henning 1967, Schwartz et al. 1981, Bernknopf , Brookshire and Thayer 1990, Beron et al. 1997, Freeman 1993, Bin and Polasky 2004, and W.A Donelly 1989). But the literature has not scrutinized the impact of water logging on the value of properties. This paper attempts to explain the effect of poor urban drainage system in the form of water-logging on residential properties represented through the rental values.

The hedonic price theory starts with the presumption that as environmental quality changes property prices would also change, indicating the scope for estimating an implicit demand function for the environmental goods by observing the property price variations. The hedonic price model estimated in this study is parsimonious; it regresses the monthly rent with 10 explanatory variables chosen through a grid search from a wide range of variables. The chosen variables are: whether the house rented is a single or multiple storey house, whether the ground floor or higher floor is rented, whether the renter's entry to the house is private or common, the square feet of living space rented, the number of rooms, the number of washrooms, the distance to market, the distance to kids' school, the distance to bus stop, and the total number of hours of water logging annually.

This study is conducted in Cuttack city of Orissa, India. Cuttack is situated about 80kms west of the coast line of the Bay of Bengal and is 25kms from Bhubaneswar, the capital city of Orissa state. The city is situated at the head of Mahanadi delta, flanked on both sides by the perennial rivers, the Mahanadi on the north and the Kathajori on the South and East. The general ground levels inside the city are low and below high flood levels of the two rivers. The sewage and storm water mixes together and finds its way into the households in many water-prone areas of the city and creates extremely unhygienic condition. The city's drainage lacks infrastructures to segregate waste water and sewage from surface run off. The tributary drains joining the main drain have been encroached upon unscrupulously and are in dilapidated state .The carrying capacity of the drain is throttled due to narrow culverts all through. Apart from this there is frequent silting due to insufficiency in channels hydraulics, constructions in the water way, encroachments and widening of roads, intrusion of electricity and telephone poles, uncivil practice of throwing garbage into drains, lower elevation of the roads, slums at several reaches, degradation of natural wet lands, streams and tanks and leakage from sluices, etc. The problems aggravate when flood water levels in the major two rivers are above the water levels in the drainage channels. This causes flood leakage. During such times, many areas in the city remain water logged while low lying areas get inundated.

As far as sampling is concerned it is undertaken with the help of two GIS maps: (A) proposed drainage map and (B) inundation map of Cuttack city. The inundation map is changing every year. So some adjustment is being made. Then both the maps are put in one map. Then forty seven clusters are made over it. All these clusters are selected on the basis of four criteria such as (1) Blue Exposed to low pocket and inundated (2) Unexposed and uninundated (3) Exposes to low pocket and uninundated (4) New drainage extension area. There are 28, 9, 5 and 5 sample points respectively in these four categories. All the points are plotted with the help of GPS. From each cluster 16 renters are selected at random. However, before final survey a review is made whether 16 renters exist in each cluster or not. In total there are 752 households surveyed.

A simple linear multiple regression model is estimated using the econometric package LIMDEP. The problem of multicollinearity is avoided partly through an observation of the correlation matrix and mainly through the software which dropped multicollinearity variables by default. The regression output corrects for heteroscedasticity. The output shows that all the chosen explanatory variables along with the intercept yield coefficients which are highly significant except the two variables: the floor rented and the distance to market. These two variables are significant at ($0.05<\alpha<0.10$) level. The rest of the variables are significant at below 1% level. Signs of the coefficient are as per our theoretical expectations. The coefficient of the environmental quality variable (the number of days of water logging) is highly significant and qualitatively of negative sign as per our theoretical expectation. The coefficient which is the implicit price of water logging implies that in order to avoid the suffering of water logging by 1 hour during a year the households are willing to pay a higher rent of 72 paisa in the house rent per month. Thus the annual implicit price of an hour of water logging is Rs.8.64 per household. Assuming this amount as the annual willingness-to-pay of one household, the annual property market valuation of the damage done by an hour of water logging to73,618 households is Rs 636,060. In terms of the marginal effect for the average 68.97 hours of water logging per annum, the implicit price is estimated at Rs 49.57 per month. This estimate of willingness to pay will definitely help the policy makers to arrange resources for providing an improved sustained urban drainage system in the city.

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