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The value of environmental (dis)amenities in the urban housing market: Evidence from Khulna, Bangladesh

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ABSTRACT

Pressure of rapid urbanization on abiotic environmental parameters in the residential blocks is one of the major challenges of city corporation authorities in Bangladesh. Environmental degradation often reduces property value in the housing market. However, the studies attempted to assess the value of environmental amenities and dis-amenities in the housing market of Bangladesh are scarce. Hence, this study examines the economic value of environmental (dis) amenities in the housing market of Khulna city, Bangladesh. Hedonic pricing method was used to assess the value of four environmental attributes - ventilation, open space, waterlogging and landfill by waste in the housing market. The study found these environmental attributes explain the variation of house rents significantly. Environmental amenities–a hundred-meter reduction in proximity to open space leads to a 2 percent increase in rent while a one discrete unit increase in a 5-point ventilation improvement scale from very poor to excellent results in 5.4 rent increase–are found as rent booster in the urban housing market. In contrast, waterlogging and landfill by waste reduce house rents by 3.7 and 9.8 percent for one unit increase in the respective 5-point degradation scales. The further analysis showed that the rental price of planned residential areas is more sensitive to ventilation and landfilling while that of unplanned areas is more sensitive to both environmental dis-amenities – water-logging and landfilling. Furthermore, our study computed the implicit price of these environmental (dis)amenities in the housing markets of Khulna city. This study suggests improving environmental quality boosts house rent, which in turn attracts environment-friendly urbanization.

1. Introduction

Planned urbanization promotes social and economic development through the advancement of physical structure, job creation, improvement in basic services and standard of living. In contrast, the negative externality of unplanned urbanization induces urban poverty, unemployment, and environmental degradation (Loton, 2004). Bangladesh has experienced a rapid progression of both planned and unplanned urbanization in recent years. In one hand, urbanization induces modernization of roads, houses, schools, hospitals, and many other infrastructures. On the other hand, it has induced severe pressure on the physical and social infrastructure, deterioration of the urban environment and increase in road-noise, social crime and unrest (Ardeshiri, Ardeshiri, Radfar, & Shormasty, 2016). Rapid urban concentration of population in large cities of Bangladesh is mostly due to rural-urban migration. The

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census of 2001 estimated that about 23.1 percent of the total population of Bangladesh lived in the urban areas (Majumder, Hossain, Islam, & Sarwar, 2007), which became about 29.38 percent in 2011 (BBS, 2015). One of the major consequences of such rapid urbanization is the increased demand for houses in the housing market of urban areas.

Houses in the urban areas are not only a consumption good but also an investment good, reflected by the rental values of houses (Umeh & Oladejo, 2015). The value of houses usually depends on locational, structural, neighborhood, community, environmental and land cover attributes (Babalola, Umar, & Sulaiman, 2013; Zoppi, Argiolas, & Lai, 2015). Structural and locational features explicitly determine housing rents (Irfan, 2007; Ooi, Le, & Lee, 2014). Households primarily evaluate structural characteristics i.e. numbers of rooms and toilets; position of flat and location; and neighborhood features i.e. proximity to schools, public space, shops, workplaces, hospitals and police stations in order to settle rent in the housing market (Schläpfer, Waltert, Segura, & Kienast, 2015; Ooi et al., 2014; Ardeshiri, 2014).

In addition, environmental quality, which are often termed as public amenities or dis-amenities with non-excludable and non-rival features, implicitly determine the rental price in the housing market. The higher the number of public amenities, the higher the value of houses and vice versa (Zoppi et al., 2015). From the built environment perspective, environmental features are also considered as a normal good, attracting higher income households to locate in regions with better environmental and neighborhood features (Carriazo, Ready, & Shortle, 2013). For example, an improved sewerage system, an environmental amenity, boosts up house rent while open sewerage, an environmental dis-amenity, in the residential block has a negative externality effect on housing price (Irfan, 2007). Similarly, other environmental amenities like parks, urban green spaces and watersheds have positive impact on housing price (Schläpfer, Waltert, Segura, & Kienast, 2015; Poor at el., 2007; Jim & Chen, 2006).

Recent studies show that the proximity of green space to houses within 1-km increases house prices by 0.08 percent. Similarly, proximity of regional and metropolitan park within 600 m add house price by 1.9 and 2.9 percent, respectively (Smith, 2010). In contrast, landfilling by wastes decreases property value. A distance of 3.25 miles from a landfill site increases house price by 18–20 percent in Alum Creek area, Obetz, Gahanna and Grove city in the United States (Hite, Chern, Hitzhusen, & Randall, 2001). Basic microeconomic theories explained these findings – environmental amenities shift demand curve outward and thus, increase the rental price while dis-amenities shift demand curved inward, which in turn reduce rental prices in the housing market (Dawkins & Nelson, 2002).

In the process of urbanization, the importance of environmental (dis)amenities in the housing market is well recognized in urban economics literature since these factors often determine several important urban policies – zoning regulations, temporal gap between housing demand and supply, and market segmentations (Jun & Kim, 2017). Hedonic price model is widely used to measure the effects of environmental amenities on the rental housing price; however, these studies are mostly concerned with the developed country scenario. This is because; the urban policy makers of the developing countries might not usually concern about the value of environmental amenities in the urban housing market as middle income people with limited budget for housing rent largely dominate this urban market. Hence, paying for environmental amenities embedded with rents for these people is often considered a luxury. In consequence, there is a dearth of literature on the effects of environmental amenities on housing price for developing countries.

However, there are some recent studies effectively pointed out the importance and value of environmental attributes in urban housing market in developing countries. For example, Xiao, Hui, and Wen (2019) revealed the value of landscape proximity on housing price in Hangzhou, China. Similarly, Du and Huang (2018) assessed the effects of urban wetlands on housing prices. Zambrano-Monserrate and Ruano (2019) estimated the effect of noise on housing rental prices from a developing country perspective in Ecuador. Though the number of literatures emphasizing the impact of several aspects of environmental (dis)amenities is growing rapidly due to its high importance from policy implication point of view, there is a dearth of such literature in Bangladesh. Concomitantly, environmental (dis)amenities are often been overlooked from the housing market as rapid urban population growth-led housing demand is immense in the existing market. Therefore, perhaps, this is the first study investigating the holistic effect and value of environmental (dis)amenities in housing market of Khulna city in Bangladesh. We proceeded with the hypothesis that environmental amenities hardly affect rental housing price in a developing country like Bangladesh where slum population is on the rise, an increase of 60.43 percent between 1997 and 2014 (BBS, 2014). In this study, we attempted to estimate the economic value of environmental (dis)amenities in housing markets of Khulna city in Bangladesh.

In this regard, we used the hedonic pricing model (HPM) to estimate households' willingness to pay (WTP) for each environmental attributes of the rented houses. The reason is that the observed rental price depends on specific and differentiated features of environmental goods, and HPM has been developed for valuing these specific and differentiated features of any asset (Rosen, 1974). It is based on revealed preference theory in which, the price of a good is determined through assessment of various features those the good holds (Smith, 2010). We further compare WTP between planned and unplanned residential area of Khulna city as unplanned residential areas follow generic growth with little or no respect for planning while planned areas are developed with direct supervision and consultation of the urban planning authority. Thus, the nature of urban growth is expected to influence households' WTP for environmental (dis)amenities in urban housing market.

In summary, this study found that both environmental amenities and dis-amenities significantly explain the variation of house rents in the housing market of Khulna city. Proximity to open space and satisfactory ventilation boost house rents while waterlogging and landfill by waste reduce house rents. In addition, the housing rent in planned residential areas is more sensitive to ventilation and landfilling and that rent in unplanned areas is more sensitive to both environmental dis-amenities - waterlogging and landfilling. However, relatively small sample size (201) is a major limitation of this study. One of the major impediments of large-scale data collection was the restricted access for the enumerators due to security reasons in the building blocks; security guards and renters often refuse to permit them to enter in without prior approval from the respondents. Secondly, we had to limit our survey time in between 5 p.m. and 9 p.m., and in the weekends due to respondents' unavailability for occupational purposes. Furthermore, we collected data only from the 2nd floor of each building to ensure homogeneity by controlling floor induced rent variation and thus, some one and two storied buildings from each study sites were left out and our population was reduced in some extent. However, such small sample for valuing environmental attributes in urban housing market is not uncommon as some recent researches valued these parameters using hedonic pricing method based on the samples often varied from 111 to 400 samples (Ardeshiri et al., 2016; Famuyiwa, 2018; Hussain, Abbas, Wei, & Nurunnabi, 2019; Won & Lee, 2018). Even though, we collected relatively small number of samples, we took every effort to attain some sort of representativeness by adopting random sampling technique.

2. Methodology

2.1. Study area and survey design

Khulna is the third-largest city of Bangladesh. The area of the city is 50.61 square kilometers. The population of the metropolitan area is around 1.02 million as of 2014 (UN, 2015). Intra-district migration is one of the consequential drivers of increasing population in this city. Both availabilities of various economic opportunities and environmental threats to the surrounding districts induced a large intra-district migration between the year 2000–2010 (Marshall & Rahman, 2013). It has led to rapid urbanization, which puts adverse impacts i.e. unplanned urban growth, waterlogging, traffic congestion, environmental pollution, development of urban slums and many other socio-economic problems in the city. Open spaces, low land, and water bodies are being transformed into planned and unplanned residential areas as a consequence of rapid urbanization (Urban Strategy, 2002, p. 1).

Khulna city is one of the fastest-growing cities in Bangladesh where new residential blocks are being developed alongside old residential areas. Khulna Development Authority (KDA), the primary governing body of urban development and expansion in Khulna city, has already completed six planned residential areas, three for low income communities in the peripheral areas and three for all income communities in the core city area. However, we selected the three residential areas of all income categories i.e., Nirala, Sonadang and Boyra. The major reasons of selecting all of these three residential blocks meet almost all necessary criteria of planned residential blocks. Alongside these planned areas, we further selected five unplanned residential blocks i.e. South-central road, Miyapara, Purba (East) Baneya Khamar, Tutpara, and Banargathi. We selected these five residential blocks from the core city areas because of their generic growth trend (before the establishment of KDA in 1961). These are the major unplanned residential areas, which are also representative to other unplanned residential areas in Khulna city. The number of unplanned areas (five residential block) surveyed is greater than that of planned areas (three residential block) as the number of unplanned residential blocks are much higher than the number of planned residential blocks in Khulna city (see Fig. 1).

Beyond the planned and unplanned dichotomy, cities of developing countries like Bangladesh have overwhelmingly characterized by informality (see also Roy, 2009). Planned urbanization is generally recognized as subdivision type development permitted and/or conducted by the planning authority, whereas a generic urban development pattern is considered unplanned. For the sake of this research objective, we consider the binary: planned and unplanned area. For quantifying the economic value of environmental attributes embedded in house rents in both planned and unplanned residential areas, we surveyed 30 households from each residential area using random sampling method. For this purpose, we listed the holding numbers and randomly selected 30 multistoried buildings from each of the selected residential areas. Therefore, a total of 240 respondents from total eight residential blocks were surveyed. After screening the dataset, data of 39 respondents were deleted due to non-response, ambiguity and incomplete information. Finally, we have a sample of 201 households of which 72 and 129 households are from planned and unplanned areas, respectively. We were forced to end up with a relatively small sample size as the enumerators of this study were impeded by the requirements of prior approval and appointment from the respondents to survey them due to security issue and limited interval of appointment time between 5 p.m. and 9 p.m. due to respondents' day-time business.

We interviewed one household head (or any other member who usually participates in the household decision-making process) from the 2nd floor of each building to control floor induced rent variation as the 2nd floor is often considered the best living space considering Bangladesh's socio-economic and environmental attributes. The process of interviewing such households only from the 2nd floor throughout the study area removes floor induced rent variation in the multi-story building. Moreover, such adoption of random sampling technique helps us to generalize the effect of environmental (dis)amenities on rental price in the urban housing market to some extent.

A semi-structured questionnaire with both open and close-ended questions was used for data collection. For clarity of understanding by both the enumerators and respondents, we translated the questionnaire into Bengali (native) language. It contained five sequential sections: general information, structural characteristics of houses, neighborhood characteristics, environmental (dis) amenities and house rent information. Four teams, each composed of three enumerators, simultaneously interviewed the selected respondents in August of 2017. Every team was led by authors or representative of the authors. The team members were the students of the final year of bachelor degree in the Economics Discipline of Khulna University. The teams were arranged in such a way that at least one member of any team is from the surveyed residential area. All of the team members were experienced and skilled in collecting survey data as they were trained about terminology, objectives, and methodology of this study and data requirements.

2.2. Data and variables

Table 1 list and defines the dependent and explanatory variables with a unit of measurement used in the interview schedule. The expected associations between dependent and explanatory variables are also summarized in Table 1. The table consists of five sections. The first section introduces the outcome variable and the rest four sections contain explanatory variables of this study.

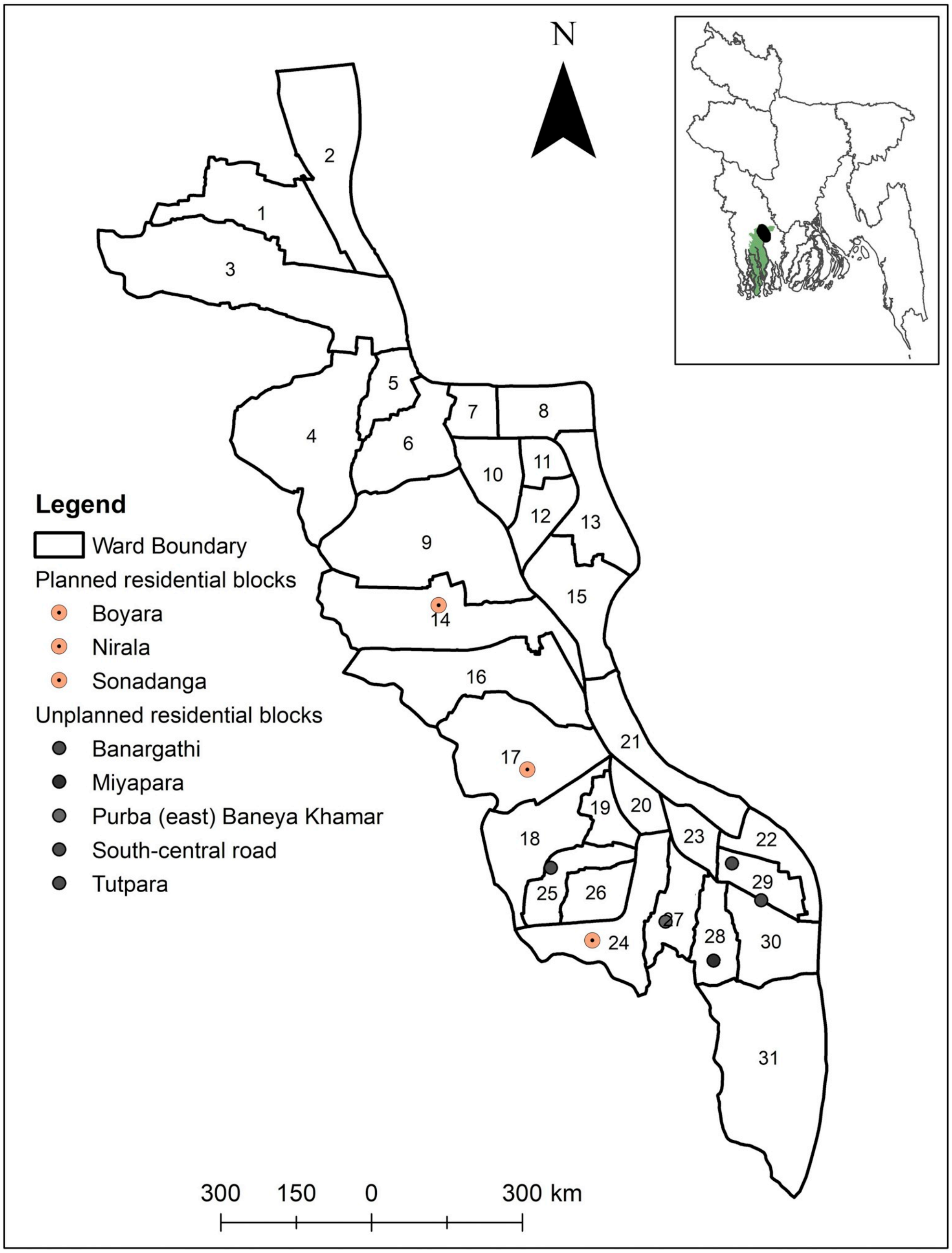

Fig. 1. Study area.

The outcome variable is the monthly house rent. It accounts flat rent and associated utility bills per month. House rent is expected to be associated with households' richness, structural, neighborhood, and embedded environmental amenities. In this study, household income accounts for the accumulated income of all earning members of the households and it is measured in thousand BDT per month. The house rent is expected to be strongly and positively associated with household income. This is because households with higher income usually prefer to rent costlier houses as suggested by basic microeconomic theory.

Beside the household income, the characteristics of physical structure predominantly explain house rents. For accounting the effect of physical structure on rent, three variables – room numbers, garage and age of the house are considered. As we interviewed households only from the 2nd floor of the house in order to preclude the potential effect of floor number, we did not include the numbers of floor in the explanatory variable list. Similarly, we did not include flat size in the model as numbers of room worked as its proxy. The number of rooms and the presence of garages are expected to impact the house rents positively while age of the house is expected to impact it negatively. On the other hand, the neighborhood characteristics account the distances from houses to the

Table 1
List of variables with explanation.

Variable Name	Explanation	Measurement Unit	Expected Sign
Dependent variable – Rent	Monthly house rent	BDT/month	
Explanatory variable			
Income	Household income	'000' BDT/month	+
Structural Characteristics			
Age of the building	Years from building built to date	Years	–
Room numbers	Number of bedrooms	Number	+
Garage	Availability of garage facilities within house	Yes/No (1/0)	+
Neighborhood Characteristics			
School	Distance to nearest school	Kilometers	–
Hospital	Distance to nearest hospital	Kilometers	–
Stationary shop	Distance to nearest stationary shop	Category [a]	–
Environmental Characteristics			
Ventilation	Very poor ventilation to very good ventilation	5-point scale	+
Accessibility to open space	Distance of at-least a small play ground	Meters	–
Water logging	No waterlogging to extreme waterlogging	5-point scale	–
Landfill	No landfilling to extreme landfilling	5-point scale	–

[a] Category 1 is ≤half a kilometers; 2 is within 0.5–1 km and 3 is above 1 km.

nearest stationary shops, hospital and school. In all these cases, the expected signs are negative, implying, the higher the distance to the nearest neighborhood variables is expected to reduce rents.

The final section of Table 1 lists and defines the variables associated with the environmental characteristics including ventilation, accessibility to open space, waterlogging and landfill. Since the construction of high-rise buildings in the congested urban residential areas becomes quite common to give residences for vast inflow of migrated people due to search for job opportunities and better living, ventilation for air and light flow decreases gradually in Khulna city. In addition, easy access to open spaces is considered to have significant market value in the urban housing market. Similarly, sporadic water logging in Khulna city is quite common during the rainy season and it is often regarded as the predictor of quality of roads and drainage system in the residential areas. The last environmental dis-amenity that we considered is landfilling by waste nearby houses as it is an indication of weak waste management system in the residential areas. For constructing 'ventilation' variable, we take a perception measurement by using 5-point Likert scale from the poorest to the excellent ventilation service of air and light flow. In addition, we measured the distance from house to open spaces i.e. park, playground or public garden in meter. We expect a positive association between ventilation and rent while increase in distance of open space is expected to reduce rent in the house market. However, variables representing environmental dis-amenities such as waterlogging and landfill are also constructed through 5-point scale reflecting low to high level of degradation. Therefore, house rent is also expected to have inverse association with the increase in waterlogging and landfill degradation level.

2.3. Theoretical background

The hedonic pricing model is a widely adopted approach in literature analyzing the rental prices of house in response to environmental attributes as it separates the implicit prices of physical and environmental attributes of houses (Schläpfer et al., 2015). It quantifies the change in property value due to a unit change in environmental attributes by controlling other structural and neighborhood characteristics (Hite, 2001). With a view to maximizing utility, consumers are willing to pay for specific attributes of the heterogeneous goods (Wen, Zhang, & Zhang, 2015). Recent studies have identified that environmental amenities and dis-amenities along with structural and neighborhood characteristics are also the essential features of housing products and the value of (dis) environmental amenities is often reflected in housing rental prices (Freeman, Herriges, & Kling, 2014). In the hedonic pricing approach, households' marginal willingness to pay for differentiated environmental amenities is computed through maximizing their utility function with respect to budget constraint as follows.

The utility function of a household in the hedonic model is:

$$\cup = \cup(\complement, H, N, Q) \tag{1}$$

where, $\complement$ is a composite good index, H refers to the structural attributes of house ($H = H_1, H_2, \ldots. H_n$),$N$ refers to the neighborhood attributes ($N = N_1, N_2, \ldots.N_n$), and Q refers to the environmental attributes ($E = E_1, E_2, \ldots..E$). We maximize households' utility, reported in equation (1) subject to following budget constraint.

$$I - CP_c - R = 0 \tag{2}$$

where, R denotes monthly income, is the prices of consumption goods included into index and refers to monthly house rents. Though the hedonic pricing approach suggests that the selling price is a function of differentiated attributes of houses. However, houses built for selling is not frequent in Khulna city as people usually buys a piece of land to construct a house – but buying condominium is increasingly gaining popularity. With the rapid progression of urbanization, renting flats of these built houses is quite common in the city. Therefore, we use rental price instead of sales value by following two recent studies, Van den Berg and Nauges (2012) and Dendup and Tshering (2015). These studies suggest house rent is the function of the structural, neighborhood and environmental attributes and thus, rent function is defined as follows.

$$R = R(H, N, Q) \tag{3}$$

$$\text{And thus,}\cdot I - CP_c - R(H, N, Q) = 0 \tag{4}$$

For maximizing the utility function, we differentiate equation (1) with respect to revised budget constraint is shown in equation (4). From this process, the following implicit price for each environmental attribute can be derived as follows.

$$\frac{dR}{dQ} = \frac{dU/dQ}{dU/dC} \tag{5}$$

Equation (5) represents the marginal rate of substitution (MRS) between environmental attributes Q and a composite good index$C$ and set them equal to the rate through which household can exchange Q for C in the housing market. The ratio of implicit price for environmental attributes and composite good is equal to one, meaning, one-unit change in the environmental attributes causes a change in rental value (R). In this study, equation (5) is estimated in order to assess the value addition and reduction by environmental (dis)amenities of house - ventilation, open space, waterlogging and landfills.

2.4. Econometric model estimation

We follow Dendup and Tshering (2015) approach for choosing appropriate functional forms among the alternatives – linear, logarithmic and semi-logarithmic form of hedonic models. Therefore, we take histograms of the dependent variable (housing rent) in both level and logarithmic forms which approximate normal distributions (See Figure A1 in appendix). We then compute detail summary statistics for both forms and find the level form is positively skewed while the logarithmic form of rent is negatively skewed. However, absolute skewness in level form is greater than that in logarithmic form. Hence, a natural logarithmic form of house rent is chosen as the dependent variable in the specification of the hedonic model. Moreover, our literature survey shows logarithmic dependent variable is often chosen to estimate demand function under hedonic pricing approach since log transformation of continuous dependent variable smoothens the data distribution and this functional form helps to compute demand elasticity of explanatory variables directly (Wooldridge, 2015).

Since equation (5) shows housing rent depends on environmental attributes Q and a composite good index$C$. We can re-write the equation (5) in the form of population regression function as follows.

$$R_i = X_i\alpha + \varepsilon_i \tag{6}$$

where, subscripts i specifies households while R_i is the natural log of monthly house rent. Vector X_i denotes a set of independent variables including housing and neighborhood featured as composite goods C and environmental attributes Q. Whereas, $\alpha$is a vector of the coefficient to be estimated andε_i is the stochastic error term. Simplification of equation (6) is as follows.

$$R_i = \alpha_0 + \alpha_1(income_i) + \alpha_2 H_{ij} + \alpha_3 E_{im} + \alpha_4 N_{in} + \varepsilon_i \tag{7}$$

where, income represents the monthly income of the head of the respondents; H represents the structural attributes – age of the building, the numbers of room and garage within the house; Eincludes the environmental attributes including ventilation, open space, waterlogging and landfills and N refers to the neighborhood attributes including school, hospital and stationary distance. Now, willingness to pay for each environmental attribute is computed by instrumenting the marginal effect of each environmental attributes on house rent estimated from equation (7) and a threshold level of environmental (dis)amenities.

2.5. Model selection

After being assured of the log-transformed dependent variable, we need to choose one between the log-level and log-log model. Therefore, we estimate both log-level and log-log hedonic regression models by using the aforementioned explained and explanatory variables in the second and final step as described in Dendup and Tshering (2015) study. In the log-level form, only the dependent variable, house rent, is taken into a natural log form. For log-log specification, we convert both the dependent variable and all continuous explanatory variables into a natural log form. However, as suggested by Wooldridge (2015), the dummy and discrete explanatory variables are not taken into natural-log form.

As most explanatory variables except income, age of the houses, distances from open spaces, hospitals and schools are categorical and dummy variable, we, therefore, do not transform these variables into logarithmic form and rest of the continuous variables are log-transformed for log-log functional form. In contrast, any of the explanatory variables were not log-transformed for log-level functional form. Finally, we used Akaike information criterion (AIC) and Bayesian information criterion (BIC) to select one final model from log-level and log-log functional forms.

$$AIC = -2 * In(likelihood) + 2 * K \tag{8}$$

$$BIC = -2 * In(likelihood) + \ln(N) * K \tag{9}$$

where, likelihood is the maximized value of likelihood function reported in equations (8) and (9); K denotes the number of parameters to be estimated; and N denotes the number of observations. Both AIC and BIC are used to measure the fitness and the complexity of the regression model. The complexity of the models are measured by $2 * K$ and $\ln(N) * K$ for AIC and BIC,

Table 2
Summary statistics.

Variable		All (N = 201)			Planned areas (N = 72)			Unplanned (N = 129)		
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
General characteristics										
Rent	BDT/month	8063	1100	20000	10618	1100	20000	6636	2500	15000
Income	'000' BDT/month	44.16	0.10	130	61.25	0.10	130	34.618	0.10	120
Structural characteristics										
Age of house	Years	17.67	3	61	12.88	3	33	20.35	5	61
Room number	One room flat	0.03	0	1				0.05	0	1
	Two room flat	0.27	0	1	0.14	0	1	0.341	0	1
	Three room flat	0.54	0	1	0.54	0	1	0.543	0	1
	Four room flat	0.15	0	1	0.32	0	1	0.062	0	1
Garage	No	0.63	0	1	0.31	0	1	0.81	0	1
	Yes	0.37	0	1	0.69	0	1	0.19	0	1
Environmental characteristics										
Ventilation	1-5 scale	2.73	1	5	2.99	1	5	2.59	1	5
Open space	Meter	375.62	0	1000	288.19	0	750	424.42	0	1000
waterlogging	1-5 scale	2.96	1	5	2.58	1	5	3.17	1	5
landfill	1-5 scale	3.33	1	5	2.90	1	5	3.57	1	5
Neighborhood characteristics										
Stationary shops	Less than 0.5 km	0.23	0	1	0.22	0	1	0.22	0	1
	Within 0.5–1 km	0.71	0	1	0.75	0	1	0.69	0	1
	Above 1 km	0.06	0	1	0.03	0	1	0.09	0	1
Hospitals	Km	2.55	0.5	4	3.16	2	4	2.202	0.5	3.89
Schools	Km	1.14	0.01	3.5	0.55	0.1	1	1.465	0.01	3.5

respectively. The lower the value of the information criteria the better the models to the dataset (Dendup & Tshering, 2015). Therefore, we chose functional form based on AIC and BIC values between the competing functional forms. We also check R^2 values, which is another method of screening models' goodness of fit. The model with high R^2 value has a better capability of explaining the variation of the dependent variable. After estimating equation (7), we found log-level functional form with lower AIC and BIC values; and higher R^2 values, implying that the log-level model is a better-fitted model in this study (see Table A1 in appendix).

3. Results and discussion

3.1. Summary statistics

The summary statistics of housing attributes are presented in Table 2. Overall average house rent is around BDT 8000 (1 USD = 83 BDT approximately) per month varying from BDT 1100 to 20000. The segregation of house rent into planned and unplanned areas shows average rent is around BDT 10,600 in planned areas while it is around BDT 6600 per month in unplanned areas. It implies that house rent in the planned area is almost 60 percent higher than that of unplanned areas. Since houses in planned residential blocks are newly built with proper planning, reflected by existence of open space, improved drainage and solid waste disposal system and architectural innovation compared to unplanned residential blocks, these may lead to wide house rent differential between planned and unplanned areas of Khulna city. Another reason for such house rent differential might be explained by income consumption effect of a normal good. In Table 2, monthly household income of planned areas is around BDT 61,000 which is 77 percent higher than that of unplanned areas. Therefore, high-income households prefer to reside in planned areas.

The structural characteristics include, age of the houses, room numbers and presence of garage. Table 2 depicts that average age of the houses around 18 years and houses in unplanned are relatively older than the planned areas in the Khulna city. In addition, a three-room-flat dominates the housing market and there is no difference is observed in this attribute across the planned and unplanned areas. More than half of the flats consist of three rooms excluding the bathroom and kitchen. However, a large dissimilarity is observed in having garage between planned and unplanned areas. Around, 69 percent of houses of planned areas have garage space while this is only around 19 percent in unplanned areas, though this is around 37 percent in Khulna city.

However, we do not observe much the difference in benefits in terms of neighborhood facilities between planned and unplanned areas as we do in case of structural characteristics. Table 2 shows that the locations of hospitals have relatively long distances from planned areas (around 2.55 km) in comparison to unplanned areas (2.2 km) though schools are located relatively closer to planned areas. This is because hospitals are located mostly at populace city center as they usually target patients from all classes of the society while newly established private kindergarten and high schools target children of well-off families in Khulna city. On the other hand, neighborhood features like stationery shop show a similar distribution in both planned and unplanned areas. Presence of stationery shops within 0.5–1 a kilometer of houses in planned and unplanned areas are 75 and 69 percent respectively, and above 1 km are 3 and 9 percent, respectively. The stationary shops located less than 0.5 km from the surveyed houses are 22 percent in both planned and unplanned areas.

For one of the most important sets of attributes–environmental attributes–in the housing market, we found some differences in terms of ventilation, open space, waterlogging and landfills between planned and unplanned areas. Table 2 reports that average

Table 3
Determinants of house rent: a hedonic pricing approach.

Dependent variable	(1)		(2)		(3)	
Log of rent	Overall		Planned areas		Unplanned areas	
Explanatory variables	Coefficient	SE	Coefficient	SE	Coefficient	SE
Income (‘000’ BDT/month)	0.0031***	0.0009	0.0015	0.0016	0.0037***	0.0013
Structural characteristics						
Age of house (Years)	−0.0023	0.0018	−0.0085	0.0064	−0.0019	0.0018
One rooms (=1)	Base category					
Two rooms (=1)	0.3915***	0.0924			0.4072***	0.0835
Three rooms (=1)	0.4772***	0.0908	−0.0137	0.1151	0.4943***	0.0814
Four rooms (=1)	0.6137***	0.1030	0.0777	0.1291	0.6826***	0.1178
Garage (=1)	0.1549***	0.0425	0.1830**	0.0803	0.1240**	0.0569
Environmental characteristics						
Ventilation (1 = Poor to 5 = Excellent)	0.0540***	0.0148	0.0785**	0.0324	0.0440**	0.0174
Open space (meters)	−0.0002***	0.0001	−0.0002	0.0002	−0.0003***	0.0001
Waterlogging (1 = No to 5 = Extreme)	−0.0369**	0.0146	−0.0601*	0.0309	−0.0201	0.0164
Landfill (1 = No to 5 = Extreme)	−0.0980***	0.0163	−0.1218***	0.0381	−0.0941***	0.0183
Neighborhood characteristics						
Stationary shop distance less than 0.5 km	Base category					
Stationary shop distance within 0.5–1 km	0.0276	0.0512	0.0309	0.0925	−0.0006	0.0646
Stationary shop distance above 1 km	−0.0563	0.0895	0.0329	0.2432	−0.1015	0.0983
Hospital distance (km)	−0.1665***	0.0505	−0.1722**	0.0756	−0.1860**	0.0882
School distance (km)	−0.2411***	0.0438	−0.0476	0.1283	−0.2540***	0.0745
Planned areas (=1)	0.0343	0.0448				
Constant	9.3288***	0.2477	9.9765***	0.4104	9.3508***	0.3778
Observations	201		72		129	
R-squared	0.7904		0.6072		0.7954	

Significant at: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

ventilation amenity score is 2.73 in Khulna city. This ventilation score is found to vary from 2.5 to 2.99 and this score in planned areas is just 0.4 point higher than unplanned areas. Therefore, ventilation service is relatively poor in unplanned areas compared to that service in the planned areas as the higher score reflects the better ventilation service. On the other hand, the lower score in the waterlogging and landfilling scale reflects less severe waterlogging and landfilling situations. Households in planned areas perceived less severity of waterlogging (2.58) than that of waterlogging (3.17) in unplanned areas. Similarly, overall landfilling severity score is 3.33, and households in planned areas experienced landfilling severity 2.90 point which is 0.67 point less than households in unplanned areas of Khulna city. Finally, average distance of open spaces from houses is about 376-m in the city and this distance is around 90-m less for residents in planned areas than unplanned areas. Therefore, residents of planned areas enjoy better ventilation, have close proximity to open spaces, experience less severe waterlogging and less landfill degradation than the residents of unplanned areas. This is because newly developed planned areas are far from the city center and these areas have more open spaces nearby these residential blocks.

3.2. Determinants of house rents in Khulna city

The results estimated from the hedonic pricing approach of equation (7) are reported in Table 3. It depicts that income of households, the number of rooms, space for garages, environmental (dis)amenities and distances from schools and hospitals significantly determine house rent in Khulna city though some degree of effects on rent differs between planned and unplanned areas. Column 1 of Table 3 reports the impact of aforementioned attributes on house rent of Khulna city. We found income is positively and significantly associated with house rent at 1 percent level of significance if all other things being constant, as expected, though the level of impact is low. A 0.3 percent increase in house rent is associated with a rise in household income by BDT 1000 per month. In addition, both of the structural characteristics – the numbers of rooms and space for the garage – positively and significantly increase house rent at 1 percent. House rents are 39, 48 and 61 percent higher for two, three and four-room flat respectively than that of one-room flat. In addition, the availability of garage space increases house rent by 15 percent at 1 percent level of significance. However, age of the house though shows expected negative association, it does not have significant impact on house rent. Among the neighborhood attributes, only proximity of stationery shops does not have a statistically significant impact on house rent in the city as a whole. However, an increase in distances by 1 km to hospitals and schools from houses significantly reduce rent by 17 and 24 percent respectively.

However, house rent in terms of structural and neighborhood characteristics between planned and unplanned areas differ. Income significantly and positively explains house rents of unplanned areas while it does not have significant impact on house rent in the planned areas of Khulna city. Similarly, the number of rooms is also found as significant determinant in unplanned areas while it is not planned areas. In contrast, space for the garage significantly increases house rent by 18 and 12 percent in both planned and unplanned areas. Distances of hospitals from houses significantly reduce the rent in both planned and unplanned areas though distances of schools significantly explain house rent of unplanned areas only. The proximity of stationery shops does not explain house rent of any areas.

After controlling all of the aforementioned determinants of house rents, all four environmental attributes – ventilation, open space, waterlogging and landfill – have a statistically significant impact on house rent in Khulna city. Segregated results showed in column 2 and 3 of Table 3 report that only open space proximity is not found significantly associated with rent in planned areas while only waterlogging does not have a significant impact on rent in unplanned areas and all other attributes exhibit expected and significant impacts in both planned and unplanned areas. In accordance with our expectation, environmental amenities increase while dis-amenities reduce house rent significantly. In Khulna city, households are willing to pay (WTP) 5.4 percent more as rent for a one-unit discrete increase in 5-point ventilation amenity scale. Such WTPs for a one-unit improvement in ventilation of planned and unplanned areas are 7.9 and 4.4 percent respectively. It implies that residents of planned areas are willing to pay almost 1.8 times as much as those of unplanned areas are willing to pay for discrete improvement in ventilation. Similarly, house rent increases 2 percent[1] for every 100-m reduction in proximity of houses to open spaces while such increase is 2 and 3 percent for planned and unplanned areas, respectively. In contrast, environmental (dis)amenities – waterlogging and landfill – around the houses reduce rent by 3.7 and 9.8 percent in Khulna city respectively for one-unit increase in 5-point degradation scale. These findings are statistically significant at 5 and 1 percent level, respectively. In both planned and unplanned areas, households are more sensitive to landfilling induced degradation than waterlogging induced degradation. In planned areas, the landfilling induced rent reduction is 12 percent, which is almost double of waterlogging induced rent reduction and in unplanned areas, the landfilling induced rent reduction is about 4.5 times the water-logging induced rent reduction.

3.3. *Value of environmental (dis)amenities in housing market*

In this section, we estimate the value of environmental (dis)amenities from estimated coefficients of equation (7) and a set of threshold values for environmental parameters reported in Table 4. In 5-point ventilation scale, point 4 and 5 represent good and excellent ventilation while point 4 and 5 in both waterlogging and landfilling scale represent bad to extreme degradation. Distance to open space below 500-m is considered as close proximity to this amenity. For this reason, we use these values as the threshold parameters for these environmental attributes. Based on these threshold values of the parameters, we quantify the value of environmental (dis)amenities in the housing market. The results show that for environmental amenities - ventilation and open space, households on an average are willing to pay BDT 1977 (USD 24) and BDT 984 (USD 12) per month more than average rent, respectively. On the other hand, for environmental (dis)amenities - waterlogging and landfill by waste, these households are willing to pay BDT 1988 (USD 24) and BDT 3496 (USD 42) less than average house rent in Khulna city. Therefore, ventilation is the most demanded attribute and thus, it alone accounts for 25 percent of the rent. In contrast, landfilling attribute reduces house rent the most by around 43 percent of the rent.

In planned areas, ventilation and landfilling lead to the most value addition and reduction to house rent contributes equally at 33 and 38 percent of the house rent, respectively. On the other hand, close proximity to open space boosts house rent by 11 percent while waterlogging reduces it by 21 percent. In unplanned areas, households also value ventilation the most accounting 11 percent of average rent while landfilling reduces rent by 40 percent. House rent, in unplanned areas, is also reduced by around 25 percent for waterlogging though open space is not highly valued as it accounts only 4 percent of rent. From Table 4, we further found aggregate negative value of environmental dis-amenities are much higher than the aggregate positive value of environmental amenities in the urban housing market in both planned and unplanned in the Khulna city. This is due to the fact that residents are more sensitive to the exposure of environmental dis-amenities than to the benefit of amenities. Hence, any presence of dis-amenities would lower down house rent. Therefore, environmental improvement through good drainage and waste management system would yield net value addition on housing rent by USD 66 per month for entire Khulna city while USD 75 and 52 for planned and unplanned areas, respectively.

4. Conclusion

In this study, we estimated the value of environmental (dis)amenities in the housing market of Khulna city. In this regard, we adopted a widely used hedonic pricing approach. To our best knowledge, this is the first attempt to investigate the contribution of environmental attributes on house rent in Khulna city of Bangladesh. It is also a comprehensive study, which includes two environmental amenities, ventilation and proximity to open space and two (dis)amenities, waterlogging and landfilling around the houses, to explain the variation in rents after controlling important structural and neighborhood attributes.

The study reveals that environmental amenities increase house rents by 5.4 percent for one-unit improvement in 5-point ventilation scale and by 2 percent for every 100-m reduction in the proximity to open space while (dis)amenities reduce rents by 3.7 percent and 9.8 percent for one-unit degradation in 5-point waterlogging and landfill scale in Khulna city. Segregated results show that ventilation is the most valued environmental attributes in both planned and urban areas since it is one of the scarcest attributes in rented houses. On the other hand, adverse effect of the landfill by waste is much higher than that of waterlogging on house rent in both planned and unplanned areas as waterlogging is a seasonal problem. More specifically, good ventilation accounts for 25 percent

[1] The co-efficient for open space proximity for entire sample is -0.0002. This implies increase in rent 0.02 percent for 1-m reduction in proximity. Therefore, for 100-m reduction in proximity, the increase in rent is 2 percent.

Table 4
Value of environmental (dis)amenities.

	Overall			Planned areas			Unplanned areas		
	BDT	USD	% of rent	BDT	USD	% of rent	BDT	USD	% of rent
Ventilation	1977	24	25	3500	42	33	713	9	11
Open space	984	12	12	1155	14	11	257	3	4
Waterlogging	−1988	−24	−25	−2228	−27	−21	−1678	−20	−25
Landfill by waste	−3496	−42	−43	−3984	−48	−38	−2624	−32	−40

of house rent in Khulna city, in planned areas, the share is around 33 percent while it is 11 percent in unplanned areas. Open space accounts only 11 and 4 percent of house rents in both planned and unplanned residential blocks, respectively. At the same time, waterlogging reduces house rent by 25 percent in both areas, and landfilling by 38 and 40 percent of house rent in planned and unplanned areas of Khulna city, respectively. This study further shows the net contribution of environmental attributes in the planned areas is more negative than that in unplanned areas since the residents in planned areas are more sensitive to environmental (dis) amenities than their responsiveness to the amenities. This study suggests that improvement in drainage and waste management system would contribute USD 66 to the rent per flat per month in Khulna city; that improvement would contribute USD 75 and 52 to the rent per month.

Environmental amenities are often considered as social infrastructure in developing countries where demand for housing surpasses the supply. In the process of rapid housing development and peripheral urban area expansion led by urban population growth, important environmental amenities are sacrificed. However, our study suggests that environmental amenities and reversing the disamenities can also be an economic value addition to the rental housing price, thus adds not only to the Gross Domestic Product (GDP) but also to environmental development in the urban areas of Khulna city. Urban planners and policy makers therefore pay attention to the availability of environmental amenities when permitting building blocks. Our study is in line with Lu (2018) which suggest that ambient environmental indicators and urban spatial structures affect premium in property value in Shanghai, China. Finally, urban planners and policy makers should ensure open space, waste collection and disposal and drainage system both from the urban planning and economic development of the city perspectives. However, the future studies are also required to estimate the value of environmental (dis)amenities on property value more holistically for larger data set integrated with more neighborhood and structural features, spatial information and objectively measure continuous environmental attributes for more precise estimates.

Appendix

Table A1
Diagnostic statistics for log-log and log-level models

	Overall		Planned		Unplanned	
	Log-log	Log-level	Log-log	Log-level	Log-log	Log-level
AIC	−5.15	**−21.37**	27.37	**25.88**	−41.96	**−49.99**
BIC	46.97	**31.48**	58.65	**57.75**	0.93	**−7.81**
R squared	0.77	**0.78**	0.61	**0.61**	0.77	**0.78**

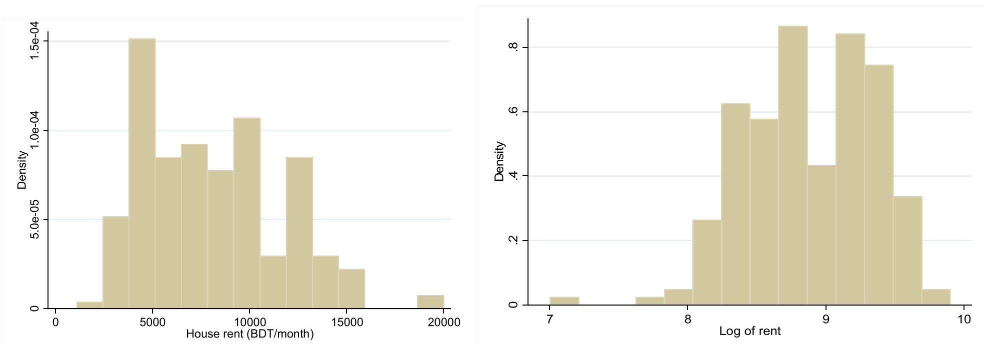

Fig. A1. Histograms of house rent.

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