Inequalities in human well-being in the urban Ganges Brahmaputra Delta: implications for sustainable development

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Abstract

Little attention has thus far been paid to wealth-based inequalities in environmentally vulnerable delta regions. Yet, ensuring equitable urban growth is key to long-term sustainable development of the deltas and beyond. Drawing on Amartya Sen's capabilities approach, the present study aims to fill this lacuna by examining the extent of inequalities in human well-being in the urban Bangladeshi Ganges Brahmaputra delta. Using the 2010 Household Income and Expenditure Survey (HIES) data, statistical analyses consider traditional inequality measures, such as concentration curves and indices, Atkinson index and regression modelling. Concentration curves and concentration indices show that intra-urban inequalities in the study area are largest in educational attainment and postnatal care. The results further show that, controlling for other socio-economic characteristics, female-headed households are more likely to experience lower levels of household consumption and females are more likely to have poorer health outcomes. Moreover, the results suggest that, *ceteris paribus,* households receiving remittances are significantly more likely to have higher levels of overall consumption. Given the rapid pace of urbanization in Bangladesh, it is crucial to develop policy initiatives aiming at reducing the existing inequalities in the region, thus contributing to the progress towards sustainable development of the country.

Key words: inequalities, human well-being, urbanization, sustainable development, capabilities, Ganges Brahmaputra delta

1. Introduction

Urbanization is currently one of the most important global phenomena affecting both natural environment and human health (Bloom, Canning, & Fink, 2008; Cohen, 2006; McDonald et al., 2011; Satterthwaite, 2006). As of 2011, approximately 52% of the world's population live in areas classified as urban (UN, 2011). Different world regions experience challenges related to either rapid rate of urban growth or urban lifestyle and health risks associated with living in cities. While populations in more developed regions are approximately 78% urban, in less developed regions, the equivalent proportion is 47 %. At the same time, in the least developed countries (LDCs) 29% of population live in urban areas, which is projected to increase to 50% by 2050 (UN, 2011). In densely populated Asian cities, the negative impacts of rapid urban growth include high rates of pollution translating into ill-health, overcrowding and housing deprivation (UNHABITAT, 2012).

In Bangladesh, urban to rural migration has been the main contributor to urban growth, and accounted for around 70% of urban growth in the city of Dhaka (Rana, 2011). At the same time, Bangladesh is one of the most vulnerable countries in the world in terms of the impacts of climate change (Leal Filho, 2011). Amongst top 39 cities exposed to natural hazards Bangladesh's Dhaka is listed as 7th most vulnerable city while Chittagong is on the 37th position (UN, 2012). The risk of floods, cyclones and other natural disasters exacerbated by climate change, including sea level rise, is particularly high in the Ganges Brahmaputra delta region. Inasmuch, push factors behind migration to cities include not only poverty and lack of employment opportunities, but also environmental hazards such as cyclones, floods and soil erosion (Alam, 2008; Mallick & Vogt, 2012). While rural poverty is still predominant in the region, similarly to the trends in other developing countries, urban poverty and intra-urban inequalities have been on the rise (Banks, Roy, & Hulme, 2011; Hossain, 2008; H. A. Khan, 2008).

A growing body of research found that in a number of countries, including in sub-Saharan Africa, intra-urban inequalities can be greater than those observed in rural locations (Fotso, 2006; Van de Poel, O'Donnell, & Van Doorslaer, 2007). Rapid growth of cities and peri-urban areas has resulted in increasing slum dwellings and greater complexities of urban areas. In Bangladesh, even within the group of urban poor, large disparities exist based on income, assets, social status and access to resources despite considerable progress in health indicators (A. M. R. Chowdhury et al., 2013; Sanderson, 2012). Human rights of the most vulnerable urban groups are often compromised as households lack access to most basic needs, such as safe food, clean water and sanitation. Based on the national data, only 43.3% of urban households have access to sanitary facilities and approximately 9.8% of urban households have no access to electricity (NIPORT, Mitra and

Associates, & ICF International, 2013). A recent study of over 1,600 slum households in Dhaka found that only 66% of children were reported to be in good health and adult literacy rate was as low as 42% (Cameron, 2011). Given the evidence of negative impacts of poorly managed or unplanned urban growth, ensuring inclusive and sustainable urbanization has now been formally included in the list of targets under the proposed Sustainable Development Goals (UN, 2014b).

In this context, the present study aims to examine the extent of intra-urban inequalities in human well-being using Amartya Sen's capabilities approach (Sen, 1983, 1999a, 1999b, 2005). We consider "well-being" to be a multidimensional concept, which involves "capability to function in a society" (Sen, 1983; World Bank, 2005). We focus on three specific aspects of well-being, i.e. health, education and overall consumption. In order to achieve its analytical objectives, we use data from the most recent Bangladesh Population and Household Census as well the 2010 Household Income and Expenditure Survey (HIES). Survey data are analysed using standard inequality measures such as ratios, concentration indices and concentration curves as well as logistic regression modelling. The next section provides a brief overview of urbanization trends at the national level. Section three describes and discusses data and methods used. In section four we discuss the results of the analysis examining the extent of intra-urban inequalities in selected well-being indicators. The final part of the paper contains conclusions and policy recommendations in the context of the recent debates pertaining to the Sustainable Development Goals (SDGs).

2. Urban growth and urbanization of poverty in Bangladesh

While still predominantly rural, in the last 60 years Bangladesh experienced rapid urban growth which has had a number of important consequences in terms of the country's human development. According to the UN data (UN, 2011), in 1950 only 4.3% of the population were urban as compared to over 28% in 2011. This was coupled with a rapid growth of urban population, which increased 26 times and exceeded 42 million in 2011. At the same time, rural population, while still considerably larger, increased 3 times reaching almost 108 billion in 2011. The annual rate of urban growth was particularly high between 1960 and 1980, when it exceeded 6%, slowly stabilizing in most recent years with an average urban growth rate of around 2.8% between 2005 and 2010. Figure 1 illustrates the trends in both urban and rural population growth, including the projected period until 2050.

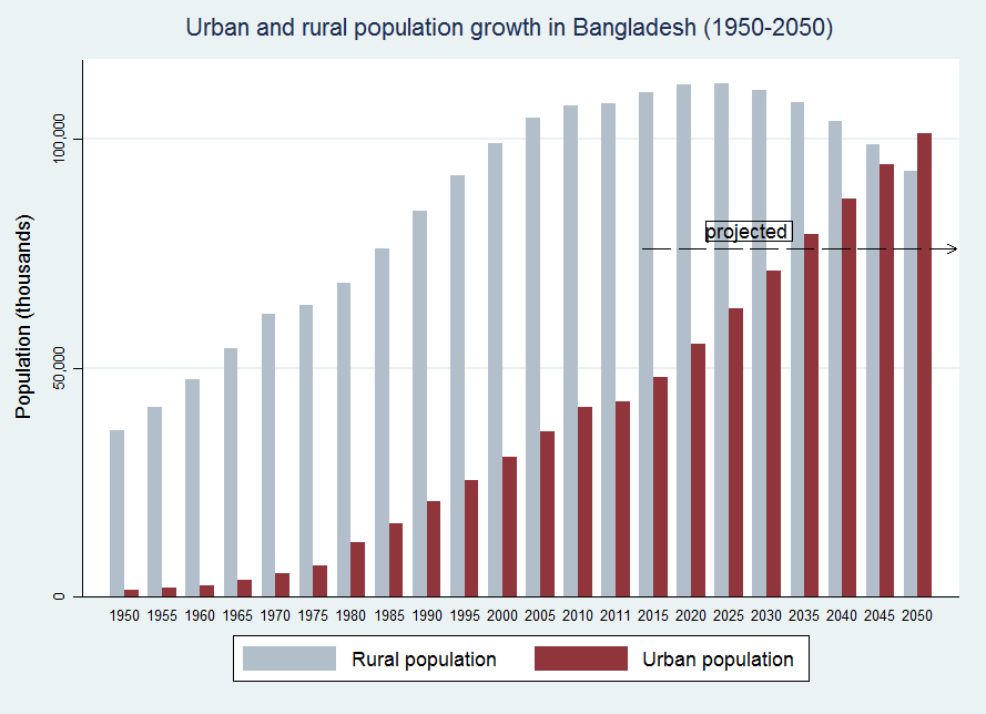


Figure 1: Trends in urban and rural population growth in Bangladesh

When comparing trends in aggregate indicators of human well-being, it can be noted that Bangladesh has achieved considerable progress. According to the most recent MDG report for Bangladesh, the country is now well on track in achieving most MDGs and has already met some specific targets, including the reduction in under-five mortality rate and targets related to communicable diseases (GED, 2013). Recent research found that Bangladesh has performed comparatively better than other countries with similar economic conditions, which could be partially explained by investments in rural development, engaging female workers in service delivery and family planning campaigns (Asadullaha, Savoiae, & Mahmud, 2014). A study published by Lancet confirmed that Bangladesh accomplished exceptional progress in health indicators despite the country's economic poverty (A. M. R. Chowdhury et al., 2013).

At the same time, however, the rapid pace of urbanization in Bangladesh coupled with often poor planning meant that large urban populations remained deprived of basic means of subsistence and their livelihoods are recurrently at risk (Rana, 2011). While the overall urban poverty has been falling, the absolute numbers of the urban poor have increased dramatically (Banks et al., 2011). In addition, research highlighted that in Bangladesh, as in other low income countries, the official urban poverty line is likely to be underestimated (Banks et al., 2011). A recent report by UNICEF (2010) points out that according to the urban slum survey (2005) approximately one third of urban population live in slums. The report also highlights that other sources estimate the number of slums

dwellers to be as high as ten million (UNICEF, 2010). The key challenges in slums or informal settlements are often related to the lack of tenure. This prevents households from benefitting from formal services, generates grounds for polarization and contributes to a continuing cycle of poverty (UNICEF, 2010). The analysis of 2009 Multiple Indicator Cluster Survey (MICS) data revealed that many socio-economic indicators in slum areas are at dramatic levels. For example, only 9% of households living in slum areas have access to an improved sanitation facility and drop out ratio from primary school is as high as 8% (UNICEF, 2010). Increasingly socio-economic inequalities, partially due to rapid urbanization , are recognised to be an obstacle to equitable human development (M. M. Khan, Kramer, Khandoker, Prufer-Kramer, & Islam, 2011).

The majority of Bangladesh's geographical area has been classified as a delta region (Ericson, Vorosmarty, Dingman, Ward, & Meybeck, 2006). In poor deltaic regions, such as the Bangladeshi Ganges Brahmaputra delta, environmental and social vulnerabilities tend to be highly intertwined. These vulnerabilities can constitute both causes and consequences of rapid urbanization, and have an impact on human well-being at the micro level. Coastal cities are likely to be affected by flooding, cyclones and other environmental consequences of climate change. Without a support net and explicit inclusion in relevant policy provisions, the poorest urban households are at a double risk of aggravating their already dire living conditions. Research found that amongst 11 Asian cities, Dhaka was most vulnerable to the impact of climate change (Banks et al., 2011). A study amongst low income urban residents in Khulna confirmed that geographic location as well as specific socio-economic contexts and environmental threats shape the way households perceive most important challenges to their livelihoods (Jahan, Shahan, Rashid, & Khan, 2012). Given the interrelationships between climate change and urbanization and the impact on both phenomena on individual capabilities and human rights, it is timely to assess the extent of the existing intra-urban inequalities in the study area.

3. Conceptual framework

The conceptual framework in this study has been motivated by Amartya Sen's capabilities and functionings approach. Distinguishing from conceptual lines of thought focused solely on the importance of financial resources, Sen argued that a person has less capability, if she has "less real opportunity to achieve those things that she has the reason to value" (Sen, 2010, p.231) . As pointed out by Clark (2005), capabilities imply that an individual has the possibility to choose their preferred options. Thus, for example, a person can have access to nutritious food and safe drinking water but can refuse consumption of it because of a strike or for religious reasons. Martha Nussbaum (2000)

stressed that Sen's concept of capabilities was directly linked to a space in which comparisons of quality of life could be made. Furthermore, the concept of capabilities is strongly linked to the freedoms that people have (e.g. political freedoms) in order to be able to realize their goals.

The capabilities approach developed by Sen is intrinsically linked to the contemporary human rights framework. Human rights are defined as "inalienable fundamental rights to which a person is inherently entitled simply because she or he is a human being" (Sepúlveda, van Banning, Guðmundsdóttir, Chamoun, & van Genugten, 2004, p.3). Within human rights one can distinguish fundamental rights, which involve the right to life and inviolability, and substantive rights, such as the right to an adequate standard of living. The latter includes the right to food, water, shelter, but also education and health. Analyzing both concepts (i.e. capabilities and human rights), Sen highlighted that a parallel existed between his capability approach and the human rights framework, although they were not the same. The key difference lay in the fact that capabilities focused on opportunities that individuals had to achieve their desired functionings, while human rights encompassed both opportunities and processes. Nussbaum (1997, p.293) claimed that maximizing individuals' capabilities should be the goal of public planning, and as such rights needed to be understood as capabilities. According to Nussbaum, a right can be conceived as a theoretical or idealistic ability of a person to fulfil their basic physical and emotional needs, as well as the provisions made for this right to be met.

Drawing Sen's approaches, the suggested conceptual framework (Figure 2) represents key pathways affecting human well-being. It is argued that both macro-level processes, such as urbanization and climate change, and household level socio-economic characteristics (including different forms of capital) constitute important elements of the capabilities environment influencing human well-being. The disparities in human well-being across different strata of the society are affected, directly and indirectly, by regional and country-level policies. In the context of Bangladesh, policy initiatives include polder and shelter construction as part of disaster preparedness plan, as well as policies aiming at mitigating the adverse effects of rapid urbanization. Policies and regulations can be perceived as both an important capability influencer and a key commodity which creates opportunities for exchange entitlements and constitute inputs to the specific components of human well-being. Different aspects of human well-being influence back initial macro and micro level factors.

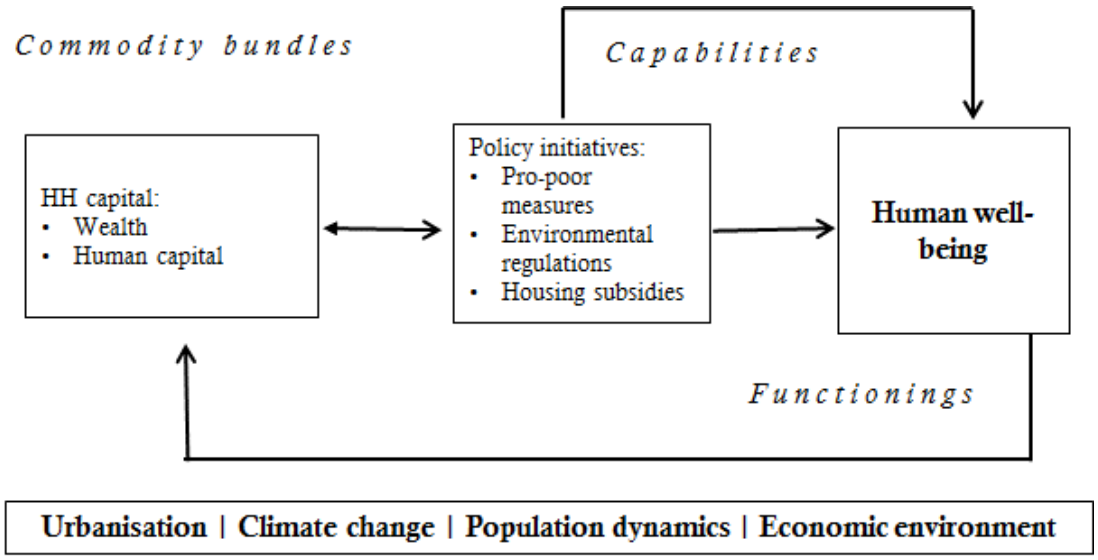


Figure 2: Capabilities and human rights conceptual framework (developed by the authors based on Amartya Sen's capabilities approach)

The developed by us framework will be used to analyze the extent of wealth based inequalities in the urban Ganges Brahmaputra delta. We focus on the last element of this framework and investigate the magnitude of inequalities in selected aspects of human well-being, i.e. education, wealth and overall consumption. In their argument on sustainability, Anand and Sen (2000a) stressed that when it comes to the question of "what is to be sustained", an inclusive approach to sustainability (and hence human well-being) is required. Such an approach has to consider specific individual entitlements, such as entitlement to clear air. In addition, sustainable development needs to account for distributional equity, including between generations (Anand & Sen, 2000b). Because the needs and preferences of future generations are largely unknown, sustainability implies an ability to reproduce the well-being as perceived by the current generation (Anand & Sen, 2000a). The discussion regarding the specific aspects of human well-being and related indicators will be further provided in the next section.

4. Data and methods

In order to investigate the extent of inequalities in the study area, we use micro level data from the 2010 Household Income and Expenditure Survey (HIES). HIES is a nationally representative survey conducted periodically by the Bangladeshi Bureau of Statistics (BBS). The overall sample size includes 4,400 urban households, while sample size for the study area comprises 3,300 urban households. Key variables of interest are household level and individual level indicators of human well-being and

include reproductive health care utilisation of household members, educational attainment and overall consumption. We classify household wealth based on wealth quintiles constructed using Principal Components Analysis (PCA). PCA is a commonly applied data reduction technique applied to generate an asset indices, which are considered to approximate household's wealth (Filmer & Pritchett, 2001; Rutstein & Johnson, 2004). The specific assets included in the index are wall material, access to key services, such as sanitation, water, electricity and internet, having a separate dining room, and selected assets (motor, fridge, TV, fan and computer). The list of variables included in the PCA together with their descriptive statistics is provided in Annex A. The first component is used to predict the values of the index.

With regards to outcome variables, we selected indicators which measure key aspects of human well-being, i.e. consumption, health and education. This selection has been motivated by both Amartya Sen's capability approach and World Bank's measurement of human well-being, which underlines the understanding of "well-being" as a multidimensional concept (World Bank, 2005). These three aspects are also the key components of the human development index (albeit, given the availability of data and level of analysis, the specific indicators used differ) (UNDP, 2013). The indicators used in the present study has been selected based on the main two criteria. The first criterion was the existing evidence based on these indicators, while the second criterion was data availability. More specifically, with regards to health, we focus on indicators of reproductive health (antenatal and postnatal care). Despite considerable progress made in healthcare coverage and healthcare outcome, Bangladesh still compares poorly with its neighbours when it comes to maternal health indicators, such as antenatal care (A. M. R. Chowdhury et al., 2013). In addition, we measure inequalities in health outcomes by using the indicator of the most commonly reported disease, i.e. gastric diseases (including ulcers). According to BBS (BBS, 2011), amongst the respondents who suffer from chronic and long term diseases approximately 24% had gastric problems with little difference between genders and place of residence. Consumption and educational attainment are treated as continues variables, while access to food and health variables are binary. Following the definition by the UNDP (2011), we consider educational attainment of adults who are 25 or older. Total household consumption comprises of food and non-food expenditure as classified by the BBS. Expenditures are standardised into monthly time periods and reported in taka.

The statistical analysis is divided into two main parts. First, we investigate wealth-based inequalities by means of descriptive statistics and standard inequality measures, such as concentration indices (CIs), concentration curves, Atkinson index and unadjusted regression coefficients. The concentration curve illustrates the extent of inequalities by plotting the shares of the well-being variable against the quintile of the wealth variable (O'Donnell, van Doorslaer, Wagstaff, & Lindelow,

2008). It is then compared against the 45 degree line, which represents perfect equality. The concentration index is defined as "twice the area between the concentration curve and the line of equality" (O'Donnell et al., 2008, p.95). The values of the concentration index range from -1 to 1, with 0 indicating perfect equality. In the case where the response variable represents a negative outcome, e.g. undernutrition, the negative value of the concentration index indicates that poorer groups are at disadvantage (O'Donnell et al., 2008). Mathematically, the concentration index can be specified as follows:

$$C = 1 - \frac{2}{n\mu} \sum_{i=1}^{n} h_i (R_i - 1).$$

where n is the sample size, μ is the mean level of health (or other well-being) variable, h_i is the well-being indicator for person i and R is the rank of the socio-economic status (O'Donnell et al., 2008).

Conversely to the concentration index, Atkinson index accounts for the variation in sensitivity to inequalities across the income distribution (De Maio, 2007). The values of the index range from 0 to 1, with 0 indicating perfect equality. As pointed out by de Maio (2007, p.850), the interpretation of the index can allow estimating the percentage of the income needed in order to achieve "an equal level of social welfare as at present if incomes were perfectly distributed". Finally, we apply multiple linear and logistic regression modelling using both adjusted and unadjusted models. Socio-economic controls, such as age and sex, are incorporated in the models in order to examine whether the magnitude and significance of regression coefficients changes when household and individual level characteristics are accounted for. Model selection is conducted using standard post estimation criteria, including R^2 and F-test for linear models, and Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) for logistic models.

5. Results

5.1 Descriptive statistics and inequality measures

Table 1 provides a summary of wealth based inequalities in household well-being by means of descriptive statistics. As can be observed, for all well-being variables there is a quasi linear decline in human well-being based on household wealth. For example, educational attainment vary from 1.5 years for those in the poorest wealth quintile to 9.2 for individuals in the richest wealth quintile. Similarly, stark differences exist in access to reproductive health care. While on average access to antenatal care is 56%, amongst the poorest households only 40% of all women are able to benefit

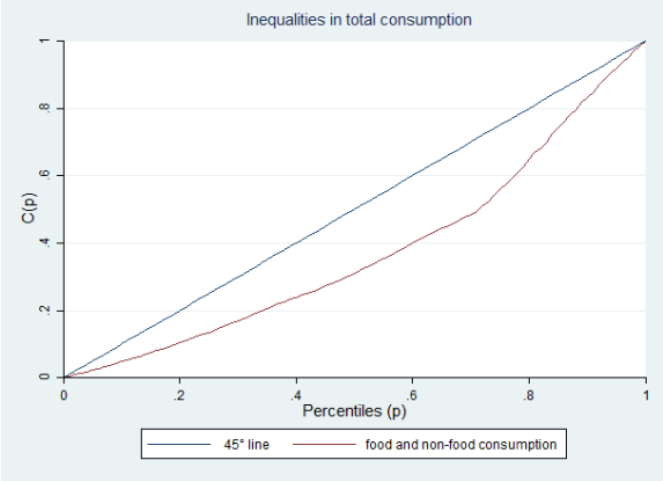
from antenatal care. The pattern is less pronounced when looking at gastric diseases, however even in this case the proportion of poorest individuals suffering from gastric diseases is higher as compared to the aggregate average.

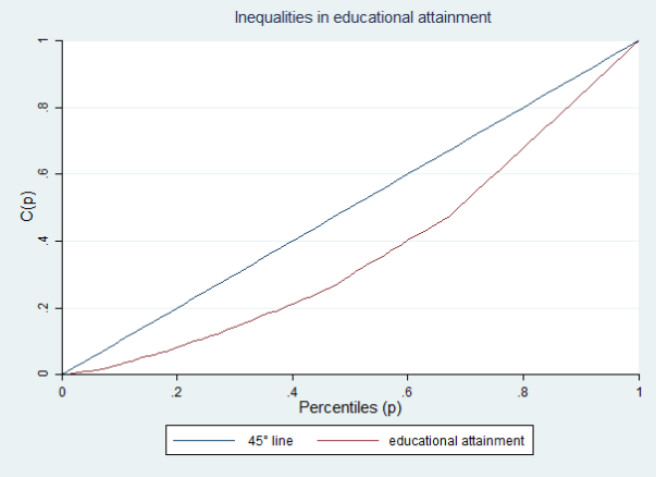
Figures 2.a) – 2.e) and Table 2 complement the descriptive analysis. Figures 2.a) – 2.e) illustrate intra-urban inequalities by displaying concentration curves for selected well-being indicators. As highlighted previously, the distance from the 45 degree line indicates the extent of existing inequalities. For the variables with negative values (such as variables as food insecurity and gastric ulcer) the inequality line would lie above the reference line, while for the variables with positive outcomes (e.g. access to antenatal care) the inequality line will lie below the 45 degree reference line. Based on the above, it can be observed that greatest intra-urban inequalities exist in access to postnatal care. On the other hand, relatively small inequalities can be seen when it comes to antenatal care and health and health outcomes measured by gastric ulcer. With regards to the latter, this can be partially explained by the fact that person to person contact is thought to be the most common route of transmission of helicobacter pylori (van Duynhoven & de Jonge, 2001) given overall poor sanitary conditions and overcrowding in the cities.

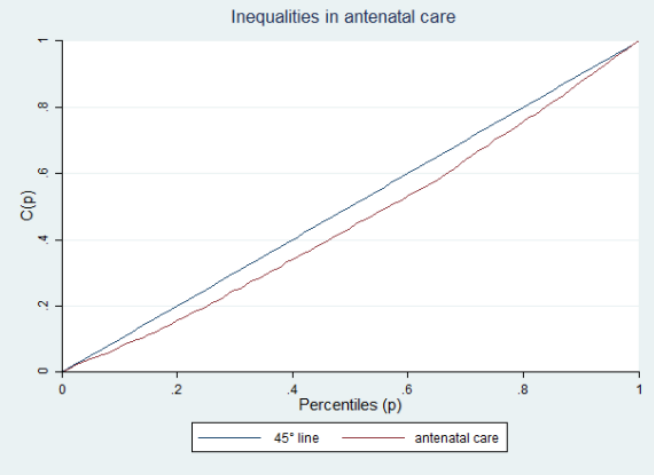
Table 1: Wealth based inequalities in household well-being

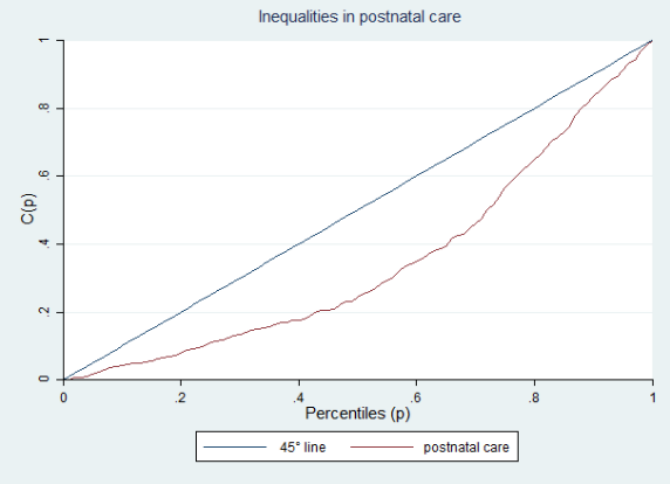
dimension of poverty	Q1	Q2	Q3	Q4	Q5	total	n
HH consumption (mean)	7,576	9,548	11,252	14,270	28,340	16,101	3,300
educational attainment of adults (mean)	1.5	3.0	3.9	5.9	9.2	5.7	7,235
antenatal care (% with access)	40.4	47.5	52.7	57.4	67.6	56.3	3,986
postnatal care (% with access)	9.6	9.3	11.1	21.2	38.9	21.4	3,986
gastric diseases/ulcer (% suffering from)	5.1	3.7	4.4	2.7	3	3.5	14,880

Figures 2a) – 2e): Inequalities in household well-being in the urban Ganges Brahmaputra delta









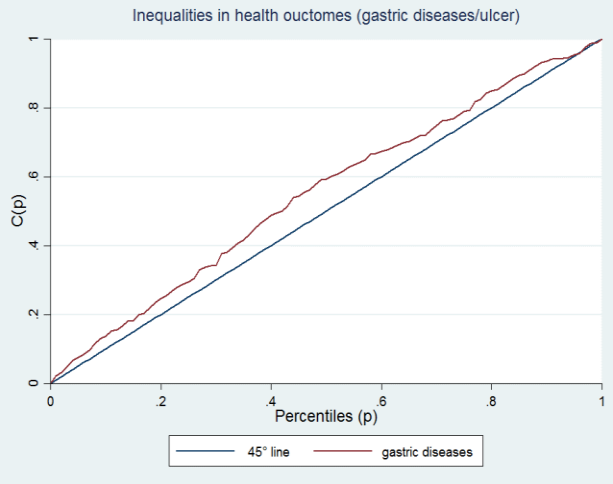


Table 2: Selected inequality measures in household well-being

dimension of poverty	indicator	CC	AI	unadjusted β	adjusted β
Overall consumption	food and non-food expenditure	0.242	0.117	1.28[1]	0.90[1]
Education	educational attainment of adults	0.256	0.373	7.66	7.93
		CC	AI	unadjusted OR	adjusted OR
Health	antenatal care (% with access)	0.090	0.437	3.08	2.56
	postnatal care (% with access)	0.273	0.786	6.00	2.70
	gastric disease/ulcer	-0.102	0.965	0.58	0.39

[1] β coefficient for logged outcome variable

Finally, the inequality measures summarized in Table 2 confirm stark inequalities in all human well-being indicators. Concentration indices suggest that greatest inequalities exist in educational attainment and postnatal care. Complementarily, unadjusted and adjusted regression coefficients show that inequalities are greatest in educational attainment, access to reproductive healthcare. Concerning over consumption, for the richest households the expected consumption will be 359.7% higher compared to poorest households and this effect decreases to 246.0% when additional socio-economic characteristics are accounted for. The full regression models are discussed in the next section.

5.2 Results of multivariate analysis

The regression results are reported in Table 3. Model 1 shows the effect of household wealth on overall consumption level when accounting for household level characteristics and place of residence. The wealth effect remains strong and highly significant ($p<0.01$). Education and age of household head are all significant at 99% significance level. For example, a ten-unit increase in educational attainment of the household head (i.e. ten years) is associated with a 20% increase in the overall consumption expenditure. Similarly, receiving remittances is associated with an increase in consumption of over 115%. Household size is also positively associated with overall consumption level, which might be explained by the fact that in larger households more household members are contributing income. In terms of regional differences, households residing in Chittagong and are most likely to have highest levels of consumption expenditure, while residing in the costal divisions of Barisal and Khulna is associated with lowest levels of household consumption.

Model 2 summarizes the determinants of education at individual level. As can be noted, there are stark wealth based inequalities when it comes to educational outcomes of adult household members. The expected educational attainment for individuals from wealthiest households is 7.9 times higher compared to individuals from poorest households ($p<0.01$). Household size is negatively

associated with educational attainment, which is also likely to be related to the fact that poorer and less educated couples tend to have larger families (NIPORT, MEASURE Evaluation, UNC-CH, & icddr, 2011). Furthermore, the results show that gender is an important predictor of educational attainment; being female is negatively associated with educational attainment. These results are in line with existing research and suggest a need for continuous scaling up of investment in girls and women, despite considerable progress made in this area in Bangladesh (A. M. R. Chowdhury et al., 2013; NIPORT et al., 2011). Finally, place of residence measured by region is also a significant predictor of education. In particular, compared to Dhaka and controlling for other factors in the model, residing in Khulna is negatively associated with educational attainment. On the other hand, *ceteris paribus,* those individuals who reside in Barisal or Chittagong are most likely to benefit from higher levels of education.

Results examining the determinants of healthcare utilization and health outcomes are presented in models 3, 4 and 5. Models 3 and 4 report the results for the determinates of reproductive healthcare utilization, while model 5 focuses on gastric diseases as the outcome variable. It can be noted that in all three models, household wealth plays an important role, and so do education and age of household head. More specifically, the odds of having access to antenatal care for women in wealthiest households are 2.56 times the odds for females from poorest households. Women from richest households are also significantly more likely to benefit from postnatal checkups (OR = 2.70, CI=1.63; 4.46). Being an older women is negatively associated with both postnatal and antenatal care, which might indicate that younger women have greater awareness of the need for reproductive healthcare and may have greater physical and financial access to healthcare facilities. *Ceteris paribus*, household size is negatively associated with postnatal care (OR=0.94, P<0.05), but not significant for antenatal care.

In terms of healthcare outcomes, the odds of having a gastric disease for individuals from wealthiest households are approximately 0.39 times the odds of individuals from poorest households. Gender is a significant predictor of gastric diseases. Controlling for other factors included in model 5, the odds of females having a gastric disease are 1.39 times the odds for males. Moreover, age and education are positively associated with the outcome. This is an interesting finding and could be explained by the fact that older individuals are less hygiene conscious. Finally, controlling for other variables, residing in Barisal, Chittagong and Sylhet (compared to Dhaka) is positively associated with the likelihood of having a gastric disease. Relevant post estimation tests are reported at the end of Table 3.

Table 3: Determinants of education and health

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	consumption	**education**	**antenatal care**	**postnatal care**	**gastric diseases**
Variable	log β (SE)	β (SE)	OR (CI)	OR (CI)	OR (CI)
wealth					
Poorer	0.19 (0.03)***	1.48 (0.33)***	1.23 (0.86; 1.76)	0.75 (0.45; 1.24)	0.68 (0.46; 0.99)**
Medium	0.35 (0.03)***	2.43 (0.28)***	1.61 (1.13; 2.30)***	0.83 (0.50; 1.37)	0.83 (0.57; 1.20)
Richer	0.47 (0.04)***	4.41 (0.32)***	1.65 (1.12; 2.42)**	1.49 (0.92; 2.41)	0.47 (0.30; 0.72)***
Richest	0.90 (0.05)***	7.93 (0.30)***	2.56 (1.72; 3.82)***	2.70 (1.63; 4.46)***	0.39 (0.26; 0.60)***
Baseline: poorest	0.00	0.00	1.00	1.00	1.00
other HH characteristics					
Education[1]	0.03 (0.00)***		1.12 (1.09; 1.15)***	1.20 (1.15; 1.25)***	1.04 (1.01; 1.06)***
Age[1]	0.005 (0.00)***	-0.08 (0.01)***	0.92 (0.91; 0.93)***	0.96 (0.95; 0.97)***	1.05 (1.04; 1.05)***
Gender[1]	-0.03 (0.03)	-1.66 (0.10)***			1.39 (1.10; 1.76)***
Baseline: male	0.00	0.00			1.00
HH size	0.13 (0.01)***	-0.13 (0.10)**	0.95 (0.90; 1.01)	0.94 (0.89; 0.99)**	1.04 (0.98; 1.09)
HH received remittances	0.15 (0.04)***		0.96 (0.66; 1.41)	1.00 (0.68; 1.49)	1.30 (0.89; 1.89)
Baseline: HH did not receive remittances	0.00		1.00	1.00	1.00
Region					
Barisal	-0.13 (0.07)*	1.92 (0.46)***	0.91 (0.68; 2.24)	1.84 (1.29; 2.63)***	1.75 (1.28; 2.40)***
Chittagong	0.18 (0.05)***	1.08 (0.45)**	3.27 (2.48; 4.32)***	4.26 (3.17; 5.73)***	1.62 (1.20; 2.19)***
Khulna	-0.13 (0.04)***	0.68 (0.30)**	1.44 (1.14; 1.83)***	1.14 (0.83; 1.57)	0.66 (0.48; 0.92)**
Sylhet	-0.03 (0.04)	0.52 (0.44)	2.27 (1.55; 3.31)***	4.49 (3.04; 6.64)***	2.28 (1.63; 3.18)***
Baseline: Dhaka	0.00	0.00	1.00	1.00	1.00

Table 2 (ctnd): Determinants of education and health

	Model 1	Model 2	Model 3	Model 4	Model 5
	consumption	education	antenatal care	postnatal care	gastric diseases
Variable	log β (SE)	β (SE)	OR (CI)	OR (CI)	OR (CI)
Constant	7.99 (0.05)***	5.93 (0.48)***	10.63 (6.21; 18.21)***	0.19 (0.10; 0.34)***	0.01 (0.00; 0.01)***
Wald chi^2			468.7	430.1	626.3
p-value			0.000	0.000	0.000
AIC			2,242.2	1,730.8	598.1
R^2	0.645	0.400			
F-test	143.9	178.8			
p-value	0.000	0.000			
number of observations	3,286	7,211	3,969	3,969	14,824

Note: [1] indicates that when a variable is at the household level (Model 1) coefficients are reported for household head. Significance levels *, **, *** are 90%, 95%, and 99%, respectively.

6. Conclusions and policy implications

Urbanization is a challenging process which affects not only the well-being of urban residents, but also those individuals and households living in peri-urban areas and the countryside. Like other developing countries, Bangladesh is becoming increasingly urban. In Bangladesh, rapid urban growth is often accompanied by economic and environmental vulnerability, in particular in the delta region. In this context, the aim of the present study was to investigate the extent of wealth-based intra urban inequalities in the Bangladeshi Ganges Brahmaputra delta. The findings of our study show that stark inequalities exist in all aspects of human well-being, as measured by selected well-being indicators. More specifically, the widest inequalities are found in educational attainment and access to postnatal health care. Ceteris paribus, for women from richest households the odds of benefiting from postnatal care are 2.7 the odds for women from the poorest households. Women from the richest households are also significantly more likely to benefit from antenatal care. Inequalities are less pronounced when looking at gastric diseases. However even in this case the proportion of poorest individuals suffering from a gastric disease is higher as compared to the aggregate average. In terms of regional differences, the results of this study show that households residing in Chittagong are most likely to have highest levels of consumption expenditure, while households residing in the coastal divisions of Barisal and Khulna are associated with lowest levels of consumption. Likewise, regional inequalities exist in educational attainment and access to reproductive health care facilities.

In the context of rapid urbanization, accesses to basic services and necessities are directly dependent on purchasing power (Bushamuka et al., 2005; UNHABITAT, 2012). For example, a program, conducted in Bangladesh entitled "NGO Gardening and Nutrition Education Surveillance Project" (NGNESP), showed that through horticulture practices income of households increased substantially thus contributing to a greater ability to access food (Bushamuka et al., 2005). With regard to the results of the present study concerning the impact of remittances on human well-being, our findings are in line with existing studies, which showed that remittances had positive effect on food and non-food consumption (Pfau & Giang, 2009; Snyder & Chern, 2009). Disparities were also found in educational attainment as urban poor mostly spend their earnings to fulfill most basic needs, such as food and shelter (Hossain, 2005). Hossain (2005) showed that more than 60% of the poor had no formal schooling and in 50% of the households at least one school-age child was not attending school at the time of the study. Negative correlation of female and educational outcomes was also found in previous studies, which may be attributed to the social context of Bangladesh which is often characterized by female seclusion and subordination as well as limited exposure to new information

(Bushamuka et al., 2005) despite recent progress in gender equity (A. M. R. Chowdhury et al., 2013). Inequalities in access to reproductive health care can be explained by the fact that in Bangladesh basic utilities are least provided to poor by concerned authorities (Hossain, 2005; Islam, 1993). Inadequate housing and use of polluted water in informal urban settlements and slum areas are a frequent cause of infectious diseases (Alirol, Getaz, Stoll, Chappuis, & Loutan, 2011; Uddin & Jones, 2000). Thus relatively low inequalities in gastric diseases can be attributed to the overall poor sanitary conditions and overcrowding in cities (van Duynhoven & de Jonge, 2001).

Ongoing and new urban development need to be more ecologically sustainable, which has been reflected in the Sustainable Development Goals agenda (UN, 2014a). Ensuring planned and equitable urban growth is a prerequisite for sustainable development (UN, 2014b). In order of the urbanization process to benefit urban populations and the society, as a whole, a number of policy measures should be considered. First, a suitable policy framework focusing on the mobilization of resources at the national and regional levels, needs be created based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions. More investments in rural development and creating livelihood options in rural areas is likely to lower migration induced pressure on cities. Second, investments ought to be increased in health infrastructure. Trainings and information sharing campaigns could be helpful in raising awareness about healthy practices amongst the poorest strata of the society. While Bangladesh has achieved considerable progress in health, including the projected achievement of MDGs 4 and 5 (A. M. R. Chowdhury et al., 2013; S. Chowdhury, Banu, Chowdhury, Rubayet, & Khatoon, 2011), universal access to reproductive health services remains a concern.

Third, upgrading of education facilities and inclusion of vocational training, information and communications technology, as well as engineering and scientific programs could make the learning process more interesting and would attract the new and left-out learners. While Bangladesh has already made considerable progress in school enrollment and reducing gender gap in access to education (A. M. R. Chowdhury et al., 2013), further investments are required in technical and specialized education, which would enable the development of specific skills required for the country to achieve its goals of poverty alleviation. Fourth, investments in developing sectors should be made keeping in mind the concept of "sustainable cities". A sustainable city can be defined as organized system that enables to meet needs of all its citizens without damaging the natural world or endangering the living conditions of other people, now or in the future (Girerdaat, 1999). Buckingham and Turner (2008) suggest that it depends on society's relationship with its environment which is a product of how powerful and influential groups in that society create, control, and maintain

knowledge. Thus, a sustainable city is a place where people live with sufficient income and free of anxiety.

Fifth, decentralization of administrative structures could facilitate good governance and effective management in the context of continuing urban sprawl. Decentralized governance involves local people in developmental activities, which is likely to increase the availability and efficacy of services. Empowering households and grass-root organizations helps to generate a sense of belongingness, which further accelerates improvements in provision of key urban services. Therefore, good governance with adequate transparency and accountability is a pre-requisite for sustainable urban development. Accountability and transparency can only be achieved through coordinated work between national and local governments and community organizations. Finally, privatization of basic services could provide access to key amenities more easily and efficiently. Economic objective of privatization include employment opportunities and control over local resources. However, privatization may also increase the cost of services, which would pose a risk to the poorest strata of the society; hence such approaches should be considered with care. All these policy recommendations would contribute to the sustainable development of the Bangladeshi Ganges Brahmaputra delta and could be applied in other geographical contexts, where rapid urban growth is accompanied by increasing wealth-based inequalities.

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Appendix A

Table A.1: Variables used in PCA

Variable	Coding	Mean
HH has electricity	1 - no, 2 - yes	87.8
HH has sanitary toilet	1 - no, 2 - yes	31.6
HH has access to improved water sources	1 - no, 2 - yes	96.6
Wall material	1 - natural, 2 - rudimentary, 3 - finished	natural – 10.9; rudimentary – 41.0, finished – 48.0
Dwelling possesses separate dining	1 - natural, 2 - rudimentary, 3 - finished	20.6
HH owns a computer	1 - no, 2 - yes	6.6
HH has internet access	1 - no, 2 - yes	2.9
HH has television	1 - no, 2 - yes	63.5
HH has a fan	1 - no, 2 - yes	81.8
HH has a fridge	1 - no, 2 - yes	30.5
HH has a motorcycle/ scooter	1 - no, 2 - yes	4.4

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