

## Local Distribution of Inequality-Adjusted Human Development Index (IHDI): A Study on Khulna

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### Abstract

UNDP Global Human Development Report 2010 under the title “The Real Wealth of Nations: Pathways to Human Development” introduced a new index, the “Inequality-Adjusted Human Development Index” to capture the distributional dimension of human development. Globally, Bangladesh has ranked 135th out of 189 countries but loses 24.3% of the value when adjusted for inequalities and this loss is 37.87% for Khulna when adjusted to the inequalities. The methodology adopted is similar to the approach of the HDR 2010 and some results are created by analyzing the results of FDG and KII and secondary sources. Based on these calculated values the wards are then ranked according to their HDI and IHDI values. As this was never done before, it produces the unique value that Khulna City has an HDI score of 0.301 which is better than the global HDI of Zimbabwe (0.140), which ranks at 169th, and when the value of Khulna City is adjusted to the inequalities, the value declined to 0.187. Further, loss resulting from inequality varies across dimensions and is highest in education (39.25%) followed by health (38.95%) and income (33.33%). Loss resulting from inequality in education is much higher than the global average of 38% and loss due to inequality in health is 44%, compared to the global average of 21%. The findings of this paper suggest that human development outcomes alone, without measurement of inequalities, may significantly mask the performance of individual cities or countries.

**Keywords:** Inequalities, Human Development Index, Inequality-Adjusted Human Development Index, Human Development Report, United Nations Development Program.

### 1. Introduction

The Human Development Index (HDI) socioeconomic indicators incorporated as -adult literacy rates, educational enrollment ratios, and life expectancy at birth, as well as a specially adjusted income-per-

capita measure- which was intended to illuminate the significant scarcities of resources and opportunities for a large proportion of the world's population. Seeking to "put people back at the center of development (Hicks, 1997) the UNDP Human Development Reports UNDP have converted the focus of economic development to include wider questions of human well-being, standard of life and quality of life (U. UNDP, 1990); (U. UNDP, 1994); (Nations, 1995); (Undp, 1997). As founded, the global IHDI was first presented in the 2010 Human Development Report (HDR).

Anecdotal research and evidence suggests for Bangladesh as being one of the poorest and most densely populated countries in the world that, its peoples' happiness level is higher than those found in other countries, including countries with larger per capita incomes with variety of accessible public goods and services and this is referred as 'developed countries' (Index, 2012). In 2012, the HDI score of Bangladesh was 0.515 and when this value is discounted for inequality, this value of HDI decreased to 0.374, results in a loss in the dimension indices distribution and the result in 27.4% inequality (Sen, 2001); (Malik, 2013).

Instead of this wide analysis of UNDP, some elements importantly inequality were not focused as much as the other areas of HDI. But as we know inequality is an important issue to be address for the ultimate sustainable development. UNDP introduced the term "Inequality-Adjusted Human Development Index" in 2010 (McGillivray & White, 1993) . The IHDI considers both the average achievements of a country on income, health, education, and how these are distributed among the taken population by "discounting" the average value of each dimension's by its level of inequality (Hicks, 1997).

Foster, Lopez-Calva, and Szekely draws on the Atkinson (1970) family of inequality proposed a composite indices that has a distribution sensitive class and this approach is based on this. The HDI dimensions distributional inequalities are captured by IHDI (Foster *et al.*, 2005). However, IHDI does not take into account overlapping inequalities whether the same people are at the lower end of each distribution, that's why it's not association sensitive and also, individual peoples' values of income and education can be zero (0) or even negative (for income). They can be adjusted uniformly to non-negative non-zero values across the countries. Atkinson inequality measure provides an approximation of the magnitude of inequality, but this reshapes the distributions to a small degree. This is why it is named the "Inequality-Adjusted Human Development Index" (Atkinson, 1970).

A decent level of inequality which is considered allowable; and also for which a country will not be penalized is set by an inequality aversion factor. In another word, their IHDI will still equal their HDI but also they can have this much of inequality (Alkire & Foster, 2010). The designation of IHDI has also include national benefits, so that national IHDI's can be decomposed by sub-groups, such as ethnic or region groups, and also to highlight the lying differences between the achievements of human development for these groups (Kovacevic, 2010); (Obádovics & Kulcsár, 2004).

As Bangladesh is a developing country that needs a strong path towards development, this development starts with a small portion of areas. That's why IHDI distribution in local areas is of great concern. Our main concern in this research is Khulna City. Khulna is the third largest metropolitan city of Bangladesh which has a population of about 1.2 million with a growth rate of 4.5% per annum (BBS, 2015). The city is beset with a number of environmental, social, political and economic problems. As a major hub with 31 wards, there exists some variations in education, health and income (three human development indices) distribution in Khulna city which sometimes results in inequality. This research helps us to identify and analyze the local distribution of IHDI within the 31 wards of Khulna City to measure the inequality and adjust them accordingly.

This kind of work on IHDI is very rare worldwide but a recent work on our neighbor country India has been reviewed (Suryanarayana *et al.*, 2016). Inequalities are becoming a growing concern nowadays in different parts of every country, making it talk of the town and increasing the necessity of understanding and reducing it. This inequality came with some amount of losses that varies across dimensions and is highest in education (43 percent), followed by health and income in India. Further loss because of inequality in education is higher than the global average of 28 percent and loss due to inequality in health is 34 percent, compared to the global average of 21 percent. Many studies have pointed out some marked differences in access to health care and its utilization in different regions. Not only the attainment of people is low in both education and health, but the extent of inequality too is also high (Suryanarayana *et al.*, 2016).

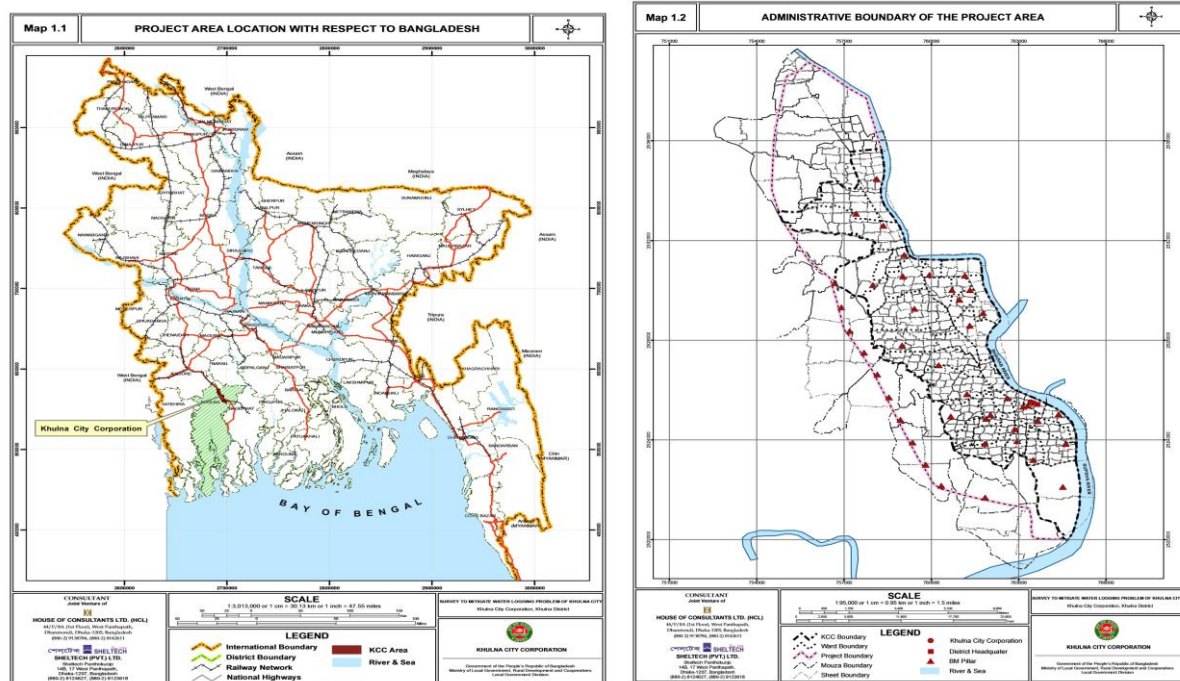
IHDI is not association sensitive, for making the measure association-sensitive, all the data must be available from a single source of survey, and this is not currently possible for many countries (Klugman, 2010). As being an association sensitive country Bangladesh can face problems in calculating IHDI locally. Since HDI along with IHDI is independent and as not being an association sensitive measure it focuses on inclusive development which is a must for sustainable development of a country like Bangladesh.

Asongu (2016) has exposed that how foreign aid can be reinvented for more inclusive and sustainable development (Asongu, 2021). Despite the fact that Africa is an underdeveloped and Bangladesh is a developing country, inclusive and sustainable development without inequalities is also important for Bangladesh. Following this, Bangladesh is developing on her HDI ranking day by day but her IHDI raking is not so impressive and that call for the local level development.

## 2. Materials and Methods

### 2.1. Study Area

**Map 1: Khulna City Map**



Source: Community Survey, 2001.

Both qualitative and quantitative methods have been followed in case of this study design (Sukamolson, 2007). The study helps to identify the local distribution of the “Inequality-Adjusted Human Development Index” and its various implications in Khulna City. Khulna is one of the seven Divisional Cities of Bangladesh. It is the 3<sup>rd</sup> largest industrial city and also an important port city of the country. The city has moderate population density with an estimated total population of about 9 lakh. Khulna Division is located in the South-West Region of the country (Map-1). The study area covers entire Khulna City Corporation (KCC) with an extended area comprising Phultola Upazila (part), Khan Jahan Ali Thana, Dumuria Upazila (part) and Batiaghata Upazilla (part). Planning area consists of 430 BS Mouza sheets of 38 mouzas of which 20 mouzas are within KCC area and the rest outside the KCC area (Map-1.2). The approximate area of the project is about 85.38 km<sup>2</sup> (19353.26 acres). Khulna City Corporation covers an area of 46.65 km<sup>2</sup> while the extended area covers about 38.73 km<sup>2</sup>. Total population of the Master Plan area is 901,794 according 2001 population census (KCC 2001). Population of KCC area is 963,000 (KCC 2020).

### 2.2. Data Collection and Data Sampling

This study was mainly based on secondary data but in some cases some primary data have also been collected, which was collected. Primary data have been collected from the key informants (e.g. Commissioners, Political Leaders, and Social Workers etc.) of the study area through key informant

schedule and FGD. Structured key informant schedule and focused group discussion have been done to collect information. It was designed both closed ended and open ended form of questions. At the beginning of the discussion, a brief introduction about the objectives and purpose of the study was given to each of the respondents and assured them that all information would be kept confidential. Then necessary information was collected from them by explaining each question clearly and asked systematically for their sound understanding. Moreover, secondary data is the main source of information in this study from various published sources as journal papers, articles, thesis paper, BBS, KCC, and KDA etc. As this research is mainly depended on secondary data, that's why this focuses on FGD and key informant survey the most.

### 2.3. HDIs based on international goalposts

Given the current Bangladesh policy goals for globalization and the MDG emphasis on development partnerships for supporting countries and regions lagging behind, it is important to examine the relative standing of Bangladesh and her cities in the international context. Hence, this paper estimates global HDIs that ultimately go with our main target IHDI distribution with reference to the same goalposts as the international ones. The methodology has been created using the methodology that is outlined in the HDR 2010 (Klugman, 2010).

**Table 1: Measurements for HDI calculation**

<b>Dimension</b>	<b>Observed maximum</b>	<b>Minimum</b>
<b>Life expectancy</b>	83.2 (Japan,2010)	20.0
<b>Mean years of schooling</b>	13.2 (US, 2000)	0
<b>Expected years of schooling</b>	20.6 (Australia, 2002)	0
<b>Combined education index</b>	0.951 (New Zealand, 2010)	0
<b>Per capita income (PPP \$)</b>	108,211 ( United Arad Emirates, 1980)	163 (Zimbabwe, 2010)

*Source:(Klugman, 2010)*

The sub-indices that are shown in the framework of UNDP 2010, for the three dimensions are given below-

$$I_x = \text{Dimension Index of 'X'} = \frac{\text{Actual value} - \text{Minimum value}}{\text{Maximum value} - \text{Minimum value}}$$

*Source: (Klugman, 2010)*

The sub-indices (HDI) is aggregated and then the geometric mean is created is obtained that is as follows:

$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

*Source: (Klugman, 2010)*

The three obtained dimensions of corresponding the Inequality-adjusted estimates are created by applying the below estimator:

$$I_{IX} = (1 - A_X) * I_X$$

Source: (Klugman, 2010)

Where  $I_{IX}$  is regarded as the inequality-adjusted index that is based on dimension, the Index of dimension is  $I_X$  and the Atkinson inequality measure by Atkinson for the dimension number 'x'th is  $A_X$ . The Report of Human Development of 2010 assumes that the value of the parameter of aversion,  $\epsilon$ , to be 1 so that the measure of the Atkinson inequality turn into-

$$A_x = 1 - \frac{gx}{\mu x} = 1 - \frac{n}{\sqrt[n]{X_1 * X_2 * \dots * X_n}}$$

$$\bar{X}$$

Source: (Klugman, 2010)

Where denotes the underlying distribution of dimension  $X$ , and  $\bar{X}$  its arithmetic mean.

Finally, the geometric mean of the inequality-adjusted HDI three indices dimension are adjusted for inequality.

$$IHDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

Source: (Klugman, 2010)

This HDI and IHDI for Khulna City wards have been made on some indices of the above International goalposts but some elements didn't go with the condition of Bangladesh. That's why some indices have been used in terms of Bangladesh's perspective. This calculation uses the Atkinson inequality measure model for the index where mean and expected years of schooling are not available in Khulna City wards. Even in FGD and KII nothing can be found. That's why only for education index, "Michael Todaro Model for HDI", which can be found in his book "Economic Development" has been used, where he used gross school enrollment and literacy rate to measure the education index. The actual indices that have been used in this research are as follows-

**Table 2: Measurements for HDI Calculation for Bangladesh**

Dimension	Maximum	Expected minimum
Life expectancy	83.2	20.0
Gross school enrollment	100% (Expected)	0
Adult literacy rate	100%(Expected)	0
Per capita Index	US\$ 1602	US\$ 100

Source: Field Survey, Researcher

## **2.4. Data Sources**

### **2.4.1. Income**

This paper has made use of the estimate of Gross National Income per capita (PPP US\$) for Bangladesh from field BBS 2016 data. Per capita income estimates forwards are worked out using the Sample Survey (SS) and focused group discussion (FGD). The minimum amount of per capita income is based on the ward survey and key informant interview (KII).

### **2.4.2. Education**

The ‘mean years of schooling of the adult population (aged 25 years and above)’ are estimated using the field survey and FGD. This same source of the data source is obtained so that in the levels of education the Atkinson inequality can be measured. Estimates of School Life Expectancy are made based on the BBS unit record data on Education in Bangladesh and gross enrollment data are based on FGD.

### **2.4.3. Health**

The health data which indicates “Life Expectancy” are estimated using NSS data along with FGD and KII. The same data source is used to obtain an estimate of Atkinson inequality in levels of health situation. BBS data are also reliable for this purpose.

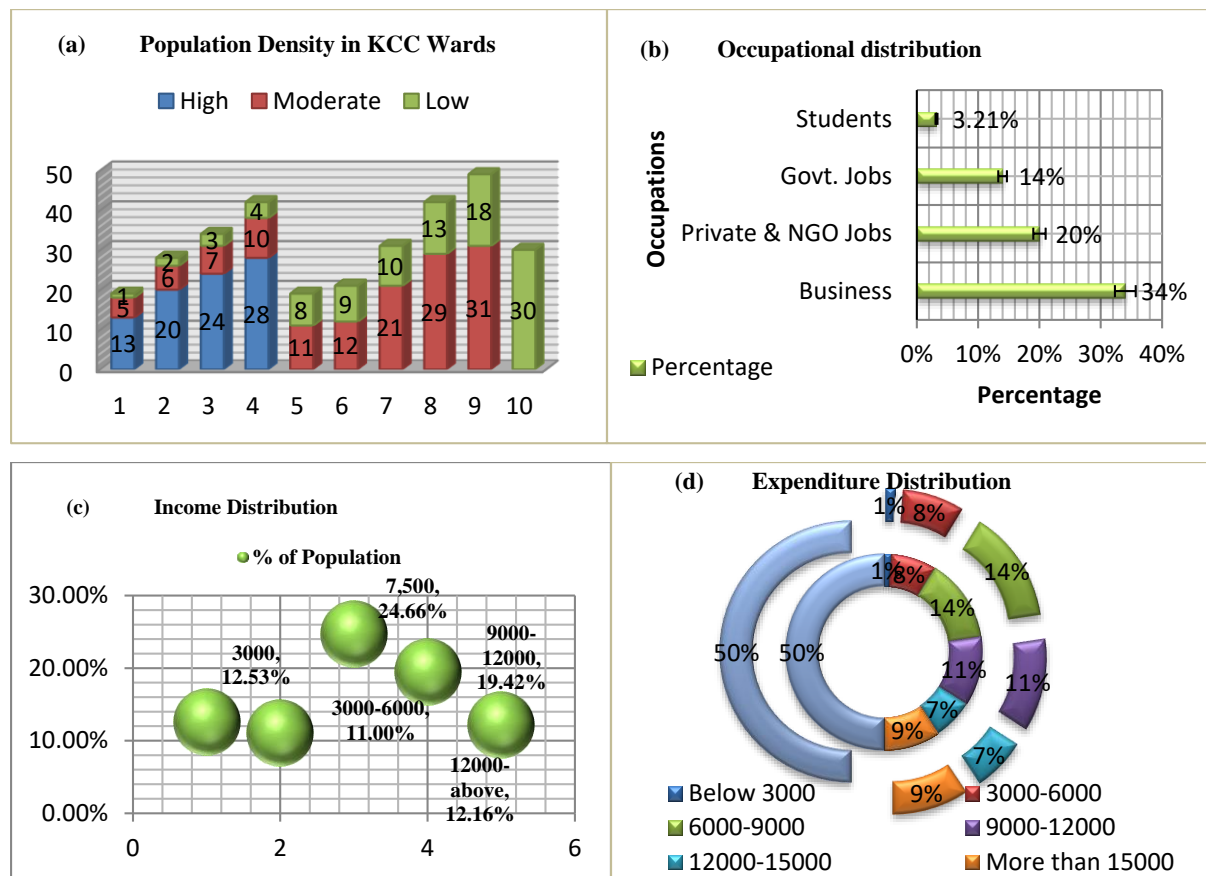
This research is based on the paper published by the UNDP-India titled “Inequality-adjusted Human Development Index for India’s Wards”. This research was done by M.H. Suryanarayana, Ankush Agrawal, and K. Seeta Prabhu (Suryanarayana et al., 2016);. No research of this kind has ever been studied in Khulna City or even in Bangladesh. This poses a research gap for this study as no research of this type has ever been discussed in our country. As suggested HDI and its results after adjusting inequalities can create great advancement for the improvement of the lives and well-being of the people of Khulna City. This research can be proved as a landmark for further researchers who are interested in human development and reducing inequalities.

## **3. Results and Discussion**

This section part describes the status of the 31 wards of Khulna City based on elements such as health, education, and standard of living. To narrow down the stress, indicators such as life expectancy, gross school enrollment, average income, and life expectancy have been observed in different parts of Khulna City. It combines both quantitative and qualitative data of life expectancy, gross school enrollment, average income, and life expectancy scenario of the KCC citizens. And these data ultimately build up the HDI and IHDI of Khulna City wards. It is found that in 31 wards of Khulna City with an area of 45.65 km<sup>2</sup>, their lives about 77, 04, 98 people (BBS, 2015). By FGD and KII it is also found that the average

gross school enrollment for KCC is 68.9%. The average literacy rate is 71.8%. In the case of life expectancy, it is 68.4 and income per capita is US\$210.20.

**Figure 1: Demographic Information of KCC**



### 3.1. HDI Measurement

This section finds the indices and elements of measuring HDI, that are health, education and income and these have been measured based on life expectancy, literacy rate, gross enrollment and average life expectancy. Data are collected from KCC wards and measured under Atkinson measure and Todaro measure of HDI (Atkinson, 1970).

#### 3.1.1. Health Index

Though most of the parts are urban area but still there is vulnerability regarding health of the citizens. There is a high rate of child mortality and maternal mortality is also on a high. For measuring health life expectancy is the main element. Regarding this some life expectancy rate can be identified. Measurement shows that 0.8% is the highest peak for life expectancy that considered as 70.2-above and this can be found in 29 (0.850) followed by 23, 25, 24 no. wards. Low rate is for 0.6% that goes for ward no. 21 (0.554) followed by 7, 16, 17, 4 etc. Whereas Figure 4.2 (b) shows the different distribution of life expectancy rate in KCC where the highest rate are for ward no. 29, 23, 25, 24, 27 which are the core



industrial areas and less life expectancy rate can be identified in ward no. 21, 7, 13, 17, 4 and rest are at a moderate level.

$$\text{Health Index} = \frac{\text{Actual Life Expectancy} - \text{Minimum Life expectancy}}{\text{Maximum Life Expectancy} - \text{Minimum Life Expectancy}}$$

*Source:* (Klugman, 2010)

### 3.1.2. Income Index

As mentioned before most of the people of Khulna City are businessman, then private job and then govt. job holder. Despite this not any major rate of average income can be found for any of the wards. In spite of being at a divisional income level is not so high as compared to Dhaka or Chittagong. Measurement shows that ward no.23 has the highest rate for income index (0.1335), ward no. 15, 29 and 25 are up next. Lowest values stand for ward no. 31 (0.0134), 17, 7, and 3. And the rest of the ward fall between these wards.

$$\text{Income Index} = \frac{\text{Actual Average Income} - \text{Minimum Average Income}}{\text{Maximum Average Income} - \text{Minimum Average Income}}$$

*Source:* (Klugman, 2010)

### 3.1.3. Education Index

As an urban oriented city Khulna City has much advancement and educational sector is one of them. Almost 60% of the population is literate. There is highest rate of literacy rate of 84.7 in the ward no. 23. But other wards such as; 29, 28, 27, 26 16, 15, 10, 11, 1, 2 (78.9%) have respective average rate of 70 (approx.). Despite this Figure 4.4 (a) shows that ward no. 3, 4, 21, 17 and others have relative less literacy rate of 60% (approx.). Gross enrollment has almost the same situation; where highest rate stands for ward no. 23 and 29 (79.8%). Lowest rate goes for 21, 3 and 4 (59%).

$$\text{Education Index} = \frac{2}{3}(\text{Adult Literacy Index}) + \frac{1}{3}(\text{Gross Enrollment Index})$$

$$\text{Adult Literacy Index} = \frac{\text{Actual Adult Literacy Rate} - \text{Minimum Adult Literacy Rate}}{\text{Maximum Adult Literacy Rate} - \text{Minimum Adult Literacy Rate}}$$

$$\text{Gross Enrollment Index} = \frac{\text{Actual Gross Enrollment Rate} - \text{Minimum Gross Enrollment}}{\text{Maximum Gross Enrollment Rate} - \text{Minimum Gross Enrollment Rate}}$$

*Source:* (Klugman, 2010)

Measurement shows that, literacy index is highest in ward no. 23 (0.831), which is followed by 29, 28, 25 and some nearby wards which constitutes almost 0.70 value of Literacy Index. The last rank is for ward

no. 21 (0.609). Last rankings are respectively grabs by 3, 7, 4 and 31 that accounts for 0.60 (approx.) values.

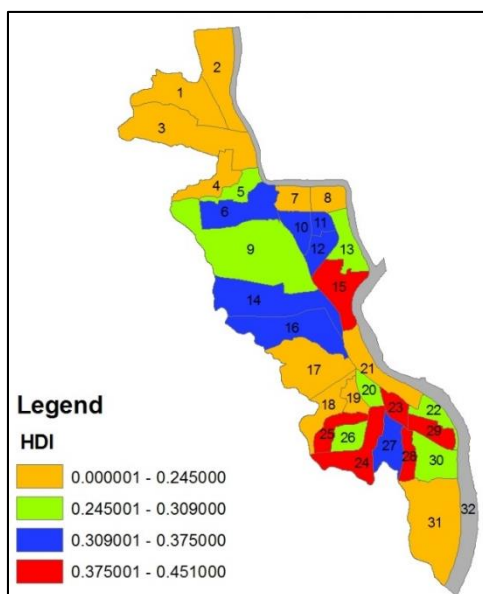
### 3.1.4. Human Development Index

Data are collected from KCC wards and measured under Atkinson measure and Todaro measure of HDI. Though most of the parts are urban area but still there is vulnerability regarding health of the citizens. There is a high rate of child mortality and maternal mortality is also on a high. For measuring health life expectancy is the main element. Here in Khulna ward no. 29 has the highest life expectancy rate of 0.850 and ward no. 21 got the lowest value in terms of health that is 0.554.

In spite of being at a divisional level, income is not so high as compared to Dhaka or Chittagong. Highest average income found is US\$300.48 for the ward no. 23. Ward no.23 has the highest rate for income index (0.1335) and ward no. 31 got the lowest value of 0.0134 for income index. As an urban oriented city Khulna City has much advancement and educational sector is one of them. Almost 60% of the population is literate. There is highest rate of literacy rate of 84.7 in the ward no. 23. But other wards such as; 29, 28, 27, 26 16, 15, 10, 11, 1, 2 (78.9%) have respective average rate of 70 (approx.).

This map shows the distribution of IHDI values in KCC wards and this reveals that the red colored area which are ward no. 23, 24, 15, 26, 28, 29, 15 and 11 have the highest value of IHDI ranges between 0.261 to 0.340 but green colored are which are 1, 3, 7, 17, 21 and 31 have the lowest score of IHDI.

**Map 2: HDI Value Distribution**



$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

Source: (Klugman, 2010)

### 3.1.5. Inequality-Adjusted Human Development Index Measurement

#### 3.1.5.1. Inequality-Adjusted Health Index

As described in the “Health Index” that the highest rank goes to ward no. 23 with 0.850 value and lowest goes for ward no. 21 with a value of 0.554. But when the rate of inequalities in the health sector that existed in the wards of KCC is added to the “Health Index”, then the “Inequality-Adjusted Health Index” can be found. By adding inequalities it is found that ward no. 23 again leads here with a value of 0.63, followed by ward no.29 (0.609), 15 (0.580), 25 (0.570). Whereas ward no. 05 with a value of 0.241 stands at the last rank. Followed by this ward no. 17 (0.241), 21 (0.244), 07 (0.25), 1 and 3 (0.28) are on the next rank.

$$I_{\text{Health}} = (1 - A_x) * \text{Health Index}$$

Source: (Klugman, 2010)

$$A_x = \frac{\text{Income Index} * \text{Health Index} * \text{Education Index}}{\text{Income Index} + \text{Health Index} + \text{Education Index}}$$

3

Source: (Klugman, 2010)

#### 3.1.5.2. Inequality-Adjusted Income Index

As like health, inequalities can also be seen in income sector of Khulna City. As shown in Table 5, the highest range of inequality stands for ward no. 23 (0.10), that is then followed by ward no. 15 and 29 (0.08) and ward no. 11, 24, 28 with a value of 0.07. Whereas the last ranking wards are ward no. 17 (0.005), 21, 7 (0.006), 31, 1 (0.008) and 8 (0.01). Attains an almost 1.5% loss from the “Income Index”.

$$I_{\text{Income}} = (1 - A_x) * \text{Income Index}$$

Source: (Klugman, 2010)

#### 3.1.5.3. Inequality-Adjusted Education Index

There are approximately 5 schools in every ward of KCC. For this the literacy rate is not so poor with an average of 70%. But when the inequality from this sector has been added it provides a different picture for the “Education Index”. In the “Education Index” ward no. 23 (0.831) stands as the first position and

last rank is for ward no. 22 (0.609). And in “Inequality –Adjusted Education Index” ranks ward no. 7 and 3 (0.26) at the last position of the index. The next bottom three are ward no. 21 (0.27), 17 (0.28), 8 and 1 (0.312). The top three goes to 23 (0.623), 29 (0.58) and 15 (0.561) as displayed in Table 4.2. Figure 4.7 distributed a 1.64% loss in IA-Education Index (0.438) from the Education Index (0.721).

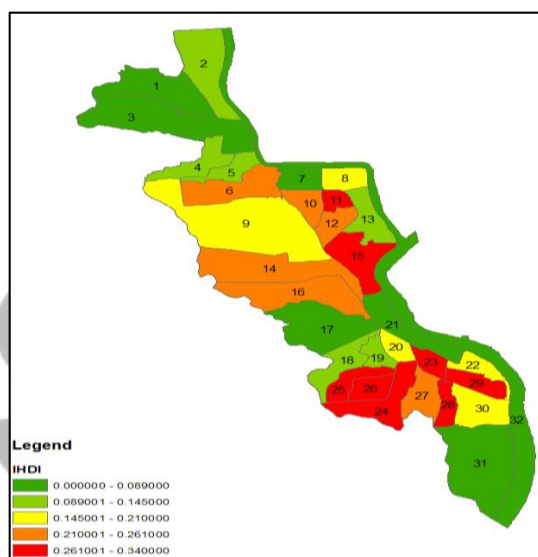
$$I_{Education} = (1 - A_x) * \text{Education Index}$$

Source: (Klugman, 2010)

### 3.1.5.4. Inequality-Adjusted Human Development Index

Map 3: IHDI Distribution

Inequality- Adjusted Human Development (IHDI) is a measure that distributional inequalities of HDI. For Khulna City the IHDI value is 0.187 where HDI value is 0.301. Where there is an estimated 1.61% loss in IHDI from HDI. As shown in Table 4.3, ward no. 23 with a value of 0.34 stands at the top and this is followed by 29 (0.304), 15 (0.297), 28 (0.28) and 25 (0.277). The last ranking wards are 3 and 21 (0.073), 7 and 17 (0.071) and 31 (0.02). Figure 4.8 provides a clear understanding that despite being at the last rank ward no. 31 (0.2) is somehow better then ward. No 23 (0.34) which stands at the first place of the IHDI, because the more value in IHDI the more you have inequalities in your part.



$$A_x = 1 - \frac{gx}{\mu x} = 1 - \frac{n \sqrt{X_1 * X_2 * \dots * X_n}}{\bar{X}}$$

Source: (Klugman, 2010)

$$IHDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

Source: (Klugman, 2010)

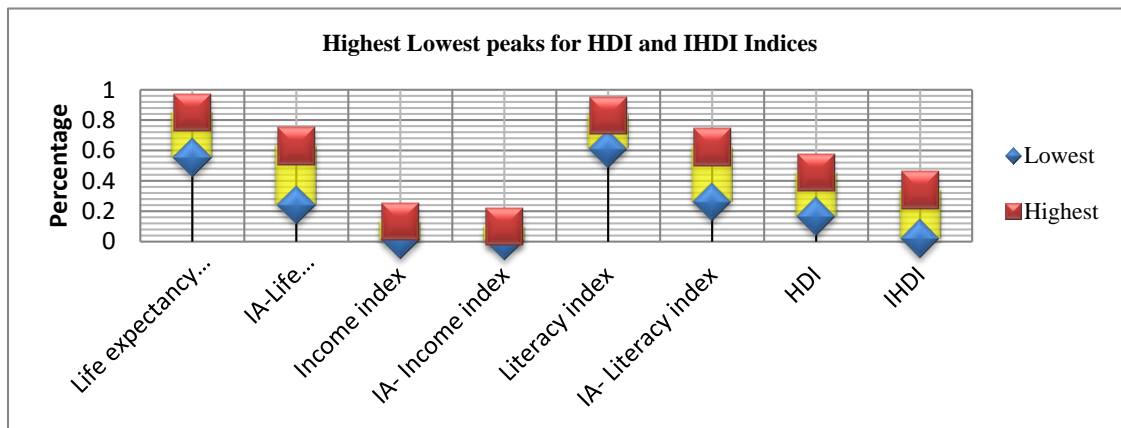
### 3.1.6. Total Loss Distribution

This loss refers to the percentage of loss due to adjusting inequalities to HDI. This loss declined the value of HDI and IHDI. Table 6 displays different rate of loss for different KCC wards. The highest loss goes

for ward no. 21 (89.07%). Where 5 (60.11%), 25 (59.22%), 28 (58.72%) and (58.58%) followed ward no. 30 to makes up the top five losers. Table 6 also shows that ward no. 11 (0.541%), 12 (18.13%) and 6 (27.81%) builds up the last three with a lesser percentage of loss, so ultimately they win and the top five lose.

Figure 3 shows that the highest and lowest peak for Health Index is between 0.80-0.50 percent, but when inequality is added they both get down and the IA-Health Index become 0.60-0.20%. Whereas the highest and lowest peak for Income Index is 0.00-0.10%, after adding inequality it become even lower. Then the IA-Income Index became 0-0.001%. Without inequality Education Index is 0.85-0.60% but after adjusting inequality this stands low. After inequality is adjusted IA-Education Index become between 0.60-0.20 percent. HDIs highest and lowest peak is between 0.5-0.20%, and when inequality is adjusted it goes down to 0.50-0.40%.

**Figure 2: Highest and Lowest peaks for HDI, IHDI and their Indices**



**Table 3: HDI and its dimensions for countries**

Dimensions	Income	Adjusted Income	Education	Adjusted Education	Health	Adjusted Health	HDI	IHDI
Normalized Index Values	0.455	0.397	0.358	0.255	0.634	0.483	0.519	0.365

Source: Based on estimates from (Klugman, 2010).

#### 4. Perspective from the World

Bangladesh with an HDI value of 0.614 falls into the “Medium Human Development” category with the ranking of 135<sup>th</sup> out of 189 countries. With this value Bangladesh falls behind the world average, as the world has an HDI value of 0.728 (Human Development Reports, 2019). Global loss of HDI for the world in 20%, where Bangladesh has a loss of 24.3%. In Bangladesh the loss in HDI is much higher than the world in total when it is adjusted to inequality (Human Development Reports, 2019). With a HDI value of

0.301, which is greater than the global HDI of Zimbabwe, Khulna itself falls under the “Low HDI” category, while its 31 wards varies in terms of HDI and IHDI values as well as ranking. The ward no. 23 has got the highest HDI value of 0.453 and this is followed by ward no. 29 with a value of 0.423. And wards with the lowest values are. 21 (0.166), 07 (0.172) and 17 (0.178) respectively. The profiles of the box plot for the HDI and IHDI of Khulna City wards highlights a major contrast among the wards. While the quartile of the upper section for IHDI is supposed to be the median for HDI across wards, even the extremist upper section values of IHDI is beyond the HDI of Khulna City wards. Using different wards the human development distribution is pronounced distinctively in Khulna if it is compared to Bangladesh overall or even with the scenario of the world.

When the HDI and IHDI distribution is skewed negatively across countries, for the wards of Khulna city wards it is skewed positively (Figure 2 & 3). And this could mean that comparatively a larger interval is spread out for the better top half section and the other bottom half left behind crafting for better policy options and efforts for shifting the focus towards reducing the existing inequalities.

## 5. Conclusion

The inequality-adjusted HDI estimates for KCC wards facilitate quantification of the potential loss due to inequality with respect to access to education and health. This paper elucidates and reviews the impact of inequalities within the status of human development outcomes of each ward. Inter-wards inequalities are likely to sum up another level of complexity to this situation, but are beyond the scope of this paper and need to be explored separately. The HDI computed using the global goalposts and goalpost keeping in mind the Bangladesh perspective classifies 6 wards as high human development wards, 15 as medium human development wards, while 11 are low human development wards. The medium human development wards show an average loss of 38 percent as a result of inequalities, while low human development wards show 43 percent loss due to inequalities on an average. This indicates that the human development outcomes alone sans inequalities measurement may mask the performance of wards in a significant manner.

An analysis of the impact of inequalities at a disaggregated level reveals that inequalities in the education dimension are the highest, which is in consonance with the findings of the HDR 2010. It calls for a special focus on areas and social groups that continue to face constraints in accessing education. Similarly, the inequalities are also high in the case of health. Many studies have pointed out marked differences in access to healthcare and its utilization. In both education and health, not only is the attainment of people low, but the extent of inequality remains high. Further research is required to explore the inter-linkages between inequalities across various dimensions and to examine the factors behind these inequalities.

## Author Contribution

**Rashmia Sultana:** Conceptualization, Data curation, Methodology, Validation, Writing-original draft, Formal Analysis, Writing-review & editing, Investigation. **Kazi Humayun Kabir:** Conceptualization, Methodology, Validation, Formal Analysis, Writing-review & editing, Supervision. **Sardar Al Imran:** Methodology, Formal Analysis, Writing-review & editing. **Kamrul Hasan:** Conceptualization, Data curation, Methodology, Formal Analysis, Writing-review & editing. **Md. Ayatullah Khan:** Conceptualization, Data curation, Formal Analysis, Writing-review & editing.

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## Appendix

**Table 4: Demographic Information of KCC Wards**

Ward No.	Area Acres	in BBS Population (2001)	Gross enrollment (%)	School Literacy rate (%)	Life Expectancy (Average)	Income (PPP \$)
01	476.86	20311	65.5	73.6	60	126.20
02	534.58	18815	66.3	75.8	60	144.23
03	951.98	23016	58.9	64.6	63	120.2
04	517.77	14299	59.2	65.8	59	150.24
05	196.65	15314	62.3	70.4	64	168.27
06	545.68	20995	69.2	76.7	67	240.385
07	113.03	14808	59.9	64.5	58	120.192
08	235.52	18545	66.8	72.2	66	132.2
09	891.32	34614	68.8	71.1	65	180.3
10	206.17	18518	70.1	76.4	68	240.385
11	94.72	19398	70.2	75.0	68	240.385
12	170.75	52036	69.8	75.5	60	216.35
13	292.69	19959	70.3	70.8	58	204.33
14	671.14	26444	71.2	75.8	67	240.385
15	355.39	25724	72.8	78.9	70	284.42
16	577.36	35881	72.6	77.8	69	216.35
17	585.82	30352	69.2	70.1	58	120.132
18	404.73	16765	69.1	72.1	59	150.24
19	123.37	26321	70.1	73.7	61	144.23
20	120.48	22539	69.9	73.2	63	180.3
21	338.43	24984	58.9	61.9	55	120.20
22	168.30	21633	69.9	72.7	62	174.30
23	125.51	18332	79.9	84.7	73	300.48
24	386.52	42959	76.7	78.3	72	240.385
25	184.35	27106	75.8	78.8	72	246.39
26	164.17	18087	69.9	72.5	62	180.30
27	206.26	31489	72.8	77.9	71	216.35
28	181.84	22404	77.1	79.2	70	246.39
29	163.60	20431	78.9	81.5	74	264.42



30	300.62	35827	69.9	72.9	66	180.30
31	993.84	32592	61.8	65.9	63	120.192
<b>Total of</b>	<b>11279.44</b> (45.65 km <sup>2</sup> )	<b>770498</b>				

Source: Field Survey, FGD and KII, 2021

**Table 5: Estimates of sub-indices by dimension, with and without adjustment for inequality**

Indices- Word no.	Health		Income		Education	
	Life expectancy index	IA-Life expectancy index	Income index	IA- Income index	Literacy index	IA- Literacy index
1	0.633	0.570	0.0975	0.068	0.783	0.550
2	0.633	0.565	0.0935	0.065	0.778	0.540
3	0.680	0.332	0.0290	0.015	0.725	0.360
4	0.617	0.535	0.0775	0.051	0.763	0.504
5	0.696	0.241	0.0134	0.005	0.698	0.280
6	0.744	0.540	0.0935	0.070	0.734	0.520
7	0.601	0.444	0.0535	0.033	0.720	0.440
8	0.728	0.521	0.0935	0.070	0.742	0.520
9	0.712	0.580	0.1095	0.080	0.769	0.561
10	0.760	0.434	0.0535	0.033	0.703	0.430
11	0.760	0.324	0.0214	0.010	0.704	0.312
12	0.633	0.630	0.1335	0.100	0.831	0.623
13	0.601	0.609	0.1094	0.080	0.810	0.580
14	0.743	0.434	0.0775	0.053	0.736	0.504
15	0.791	0.520	0.0935	0.066	0.739	0.516
16	0.755	0.513	0.0935	0.064	0.743	0.502
17	0.601	0.560	0.0975	0.070	0.790	0.561
18	0.617	0.406	0.0535	0.040	0.716	0.494
19	0.649	0.400	0.0485	0.030	0.718	0.431
20	0.680	0.34	0.0335	0.020	0.711	0.390
21	0.554	0.430	0.0134	0.008	0.650	0.397
22	0.666	0.244	0.0135	0.006	0.609	0.270
23	0.839	0.323	0.0290	0.015	0.726	0.370
24	0.823	0.340	0.0334	0.018	0.636	0.350
25	0.823	0.280	0.0134	0.055	0.627	0.260
26	0.666	0.420	0.0535	0.033	0.721	0.440
27	0.807	0.383	0.0388	0.021	0.677	0.372
28	0.790	0.250	0.0134	0.006	0.630	0.260
29	0.850	0.280	0.0174	0.008	0.709	0.312
30	0.730	0.403	0.0695	0.011	0.706	0.473
31	0.700	0.509	0.0775	0.051	0.761	0.510
KCC	0.706	0.431	0.0600	0.040	0.721	0.438

Source: Field Survey, FGD and KII, 2021

**Table 6: HDI and IHDI estimates across KCC Wards**

Word no.	HDI	IHDI	Loss (%)	Rank HDI	Rank IHDI	Difference
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1	0.398	0.277	30.40	26	26	0
2	0.391	0.270	30.95	23	24	-1
3	0.239	0.122	48.95	28	27	1
4	0.363	0.240	33.88	24	22	2
5	0.178	0.071	60.11	20	20	0
6	0.374	0.270	27.81	9	8	1
7	0.304	0.186	38.82	30	29	1
8	0.372	0.222	40.32	25	14	11
9	0.405	0.297	26.67	16	17	-1
10	0.299	0.183	38.80	7	9	-2
11	0.222	0.210	05.41	8	6	2
12	0.453	0.340	18.32	13	12	1
13	0.423	0.304	28.13	14	23	-8
14	0.331	0.230	30.51	10	13	-3
15	0.372	0.261	29.84	3	3	0
16	0.375	0.254	32.27	12	11	1
17	0.400	0.280	30.00	29	30	-1
18	0.294	0.200	31.97	21	21	0
19	0.287	0.173	39.72	22	25	-3
20	0.245	0.139	43.27	17	18	1
21	0.183	0.020	89.07	31	28	2
22	0.166	0.073	56.02	19	19	0
23	0.238	0.122	48.74	1	1	0
24	0.236	0.130	44.92	6	7	2
25	0.179	0.073	59.22	5	5	0
26	0.297	0.183	38.38	18	15	2
27	0.264	0.145	45.08	11	10	1
28	0.172	0.071	58.72	4	4	0
29	0.200	0.089	55.50	2	2	0
30	0.309	0.128	58.58	15	16	1
31	0.355	0.237	33.24	27	31	-3
KCC	0.301	0.187	37.87			

*Source:* Field Survey, FGD and KII, 2021