

# Spatiality of a multidimensional poverty index: a case study of Khulna City, Bangladesh

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**Abstract** Poverty is a multidimensional phenomenon, and spatiality is an important dimension for defining a multidimensional poverty index (MPI). Acknowledging the fact that spatiality is dependent on scale, the MPI of six slums, selected to cover a range of tenure types (public, private, and private freehold), was measured to determine the intra-urban variation of poverty in Khulna City, Bangladesh. Five dimensions were considered to measure the MPI: economic, social, infrastructure, political, and spatial, and an analytic hierarchy process was used to calculate the weights of the indicators. The majority of the slum dwellers were found to be multidimensionally poor, rather than income poor, and the spatial dimension had a considerable impact on urban poverty. By calculating the MPI and identifying the contribution of the spatial dimension to poverty, this research could help policy makers to determine appropriate policy and intervention measures to reduce urban poverty.

**Keywords** Urban poverty · Slums · Spatiality · Multidimensional poverty index (MPI) · Bangladesh

## Background

Reducing poverty has long been a priority of international policy. The importance of addressing the poverty issue was reflected by its inclusion as the first priority in the Millennium Development Goals (MDGs). The MDGs target of reducing the number of extreme poor (defined as earning less than US\$ 1/day, later increased to US\$ 1.90/day) by more than half was achieved ahead of time. In 2015, 700 million fewer people lived in extreme poverty compared with in 2010 (Churchill and Smyth 2017). However, despite this impressive progress in reducing extreme poverty, 836 million people worldwide continue to be extremely poor (United Nations 2015). Reducing extreme poverty continues to be the first priority of the Sustainable Development Goals, which are to be achieved by 2030.

In developing countries such as Bangladesh, urbanization is often considered synonymous to the influx of rural poor people into the cities. Some researchers perceive this phenomenon positively as a strategy for reducing and coping with rural poverty (Cali and Carlo 2012), whereas others consider it negatively owing to the mounting pressure on housing, utilities, and services (Healy and Ooms 2006). The poor rural

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migrants add to city's burden of a large slum population and experience multifaceted deprivation, including the lack of access to employment, adequate housing and services, social protection, health services, education, and personal safety and security. These can all be considered the manifestation of urban poverty. The 21st Century can thus be referred to as a period of urbanization of poverty (Ravallion 2008), during which slums have made up a significant portion of the urban population in developing countries. Recognizing these facts, the World Bank defines urban poverty as a multidimensional phenomenon (World Bank 2008).

Urban poverty prevents people from having acceptable living standards and denies them access to public services and facilities. Access to public amenities and information networks, quality of education, availability and quality of health care services, and many other similar factors determine quality of life and opportunities for social mobility (Jargoskym 2014). For example, people living in a well-governed city (i.e., with accessibility and proximity to infrastructures and services) with an income close to the poverty line may not be poor because they can send their children to school, access medical services when needed, and live in a legal house without the constant fear of eviction. In contrast, people living in a poorly governed urban center with an income over the poverty line may be poor as a result of the inadequate infrastructure and services, lack of tenure security, and other similar problems (Satterthwaite 1989). According to Deichmann (1999), access to markets and the availability of education and health facilities influence the well-being of households. In 2012, the United Nations Statistical Division (UNSD) found that a limited transport network and limited connectivity to the market, job centres, and government services not only hampers the economic performance of a community, but also isolates that community from other well-connected communities. Such isolation discourages the community from producing goods for market, and poverty increases as a result (UNSD 2005).

To reduce poverty, it first needs to be measured to ensure proper monitoring and implementation of poverty reduction programs and to increase the efficiency of these programs (GOB 2016). The first attempt to measure poverty was by Rowntree (1901) in England, and since then several authors have introduced methods of measuring poverty in different

countries. These include measures of the severity of poverty, incidence of poverty, poverty gap index, absolute and relative income poverty measures, subjective poverty measures, and the human development index (Coudouel et al. 2002; Haveman and Mullikin 1999). The methods fall mainly into two approaches, the direct, or consumption, approach used in Europe, the USA and Latin America, and the indirect, or income, approach, which is a popular official poverty measure in most developing countries (Alkire and Santos 2014; Banks 2011; Ringen 1988).

Owing to several limitations, the indirect approach cannot be used to accurately measure urban poverty. First, income poverty overlooks non-food items. The definition of the income poverty line is based on the cost of a 'minimum' food basket, assuming that people spend 70–85% of their total income on food. It does not consider non-food items, such as fuel, housing, or healthcare. However, Satterthwaite (1989) found that the urban poor spend more than 30% of their total income on non-food items. Second, attaining a certain level of income does not ensure that the minimum basic needs are met owing to differences in consumption patterns; this was iterated by Sen (1981) by emphasizing the importance of non-food items in poverty measurement (Alkire and Santos 2014). Finally, the income poverty measure does not consider the spatiality of living costs, which are considerably higher in urban areas than in rural areas (Wratten 1995, p. 11).

Responding to these criticisms, Alkire and Foster (2011) developed a multidimensional poverty index (MPI). This MPI was viewed through a one-dimensional lens by merging all the dimensions into one, and poverty was identified based on a single cutoff or threshold (Alkire and Foster, 2011). The objective of the MPI was to identify those who failed to meet a certain level of resources, needs, or functioning to maintain a minimum standard of living (Alkire and Santos 2014; Walker 2015) and poverty was measured using three dimensions: education, health, and standard of living.

Although poverty is a multidimensional phenomenon, poverty discourse often prioritizes economic factors over non-economic ones (e.g., Adams 2004; Fan et al. 2000). However, there is growing interest in exploring the role of socio-economic, cultural, disease, geographic locale, and institutional factors that contribute to income distribution and

poverty (Acemoglu and Johnson 2005; Ashraf and Galor 2013; Churchill and Smyth 2017). The MDGs have also resulted in the incorporation of other dimensions, for example, spatial and political dimensions, into Alkire and Foster's MPI to make it applicable to developing countries, such as Bangladesh. However, despite growing interest in urban poverty interventions, there is very little information on the importance of urban space as a measure of poverty.

Urban slum settlements tend to be located in vacant public or private land, often on low-lying natural disaster-prone areas. Depending on their location, the slum dwellers often remain unrecognized by the government authorities and are excluded from different public services and facilities (Begume and Moineddin 2010). The inclusion of a spatial dimension in the MPI may therefore help in finding spatially disadvantaged groups in urban areas. This study thus seeks to answer the question “how does spatiality affect the MPI?”

This paper explores five dimensions (economic, social, infrastructure, political, and spatial) of poverty in six slums of Khulna City, Bangladesh. In doing so, it tries to identify the impact of the spatial variable(s) on urban poverty. In addition, spatial variation occurs on different spatial/regional scales, in different states and metropolitan areas, and even between neighborhoods (Jargoskym 2014). To address this variation in Bangladesh, different poverty lines have been estimated for each of the 16 different urban areas (Bekar 2008). However, there has so far been no effort to determine the intra-urban spatial variation of poverty. This study thus aims to highlight the differences in intra-urban slum poverty in Khulna City, Bangladesh.

Against this background, the second section of the paper explains the selection of the dimensions and indicators of the poverty index. The third section describes the study area and data collection. The fourth section is the methodology used for the analysis. The fifth section is the analysis and findings, and the concluding remarks are in the final section.

## Indicators of MPI

Alkire and Foster's (2011) multidimensional approach (AF MPI approach) is the most popular multidimensional poverty measure. It is widely used, flexible and

more mature than other multidimensional poverty measures, such as the human development index, inequality-adjusted human development index, and gender inequality index. The Human Development Report of the United Nations Development Programme published the MPIs of over 104 countries using the AF MPI approach (Liang and Xiaolin 2013). Since then, several authors have used the MPI approach to consider different dimensions and indicators. For example, Liang and Xiaolin (2013) constructed an MPI in China using five dimensions: employment, education, housing, health, and environment. Sulaiman et al. (2014) remodeled Alkire-Foster's MPI using five different dimensions: economics, environmental hazards, financial accessibility, living conditions, and social fragmentation. Gebreslassie (2015) measured urban poverty in the Afar Regional State in Ethiopia using seven different dimensions: energy for cooking, house quality, house congestion, health, education, per capita income, and electrification.

In this paper, 20 indicators for five dimensions have been used to measure the MPI of Khulna City, Bangladesh. The five dimensions reflect the deprivation of the urban poor, and are namely economic, social services, infrastructure, political, and spatial dimensions (Table 1). The selection of dimensions and indicators is very important for constructing the MPI, and was carried out considering the reasons below.

First, the economic dimension helps understand the financial/income capacity of the poor to maintain a decent living. The four indicators of this dimension are employment status, savings, loans and asset ownership. A household is considered deprived on the economic dimension if it fulfils one of the following criteria: (1) no household members have a regular source of income for at least 6 months; (2) the household cannot regularly save a minimum amount for at least for 6 months; (3) the household takes out loans for food, treatment, and/or marriage—this indicates that the household cannot fulfill these needs with their income; (4) the household does not have any tangible assets, such as a television, mobile, refrigerator, bicycle, motorcycle, or car. The poor use these various assets (tangible and intangible) and resources to overcome economic vulnerability in the present and future (Ehrenpreis 2006).

**Table 1** Poverty dimensions and indicators

Dimension	Indicators	Source
Social dimension	Years of schooling	Martinez et al. (2008), Moser (1998), Satterthwaite (1989), Alder (1995)
	School enrollment	
	Child sickness	
	Child mortality	
Infrastructure dimension	Cooking fuel	Majale (2008), Mitlin and Satterthwaite (2002), Alder (1995)
	Electricity	
	Sanitation	
	Drinking water source	
	Housing floor	
Economic dimension	Employment	Ehrenpreis (2006), McClelland and Macdonald (1998)
	Savings	
	Asset ownership	
	Loans	
Political dimension	Voting rights	Hackenbroch (2013), Banks (2008), Hossain (2006)
	Access to law and order	
Spatial dimension	Distance to education from home	Jargoskym (2014), United Nation Statistics Division (2005), Grant (2010), Deichmann (1999), Moser (1995)
	Distance to workplace	
	Distance to water source	
	Distance to hospital	
	Distance to market	

Second, the social service dimension, which includes education and health facilities, reflects the capability of the urban poor to enhance their individual wellbeing. Households with less educated heads and households who do not send their children to school are more likely to be poor (Moser 1998; Satterthwaite 1989). Five years of schooling or primary education and enrollment of children in school are taken as the standards for determining educational deprivation. A household is considered deprived if any household member over the age of 15 years has not completed primary education. Likewise, the drop-out of school aged children (6–15 years) determines a household's educational deprivation.

The provision of health services and treatment is a basic need for all (Alder 1995) because poverty is directly linked with morbidity and mortality (Majale 2008). Frequent child sickness and mortality create extra pressure on the family income, and poor living conditions increase the rate of child morbidity, mortality, and sickness (Alder 1995; Majale 2008;

Mitlin and Satterthwaite 2002). Frequent child sickness and the under-five mortality rate are thus taken as indicators of health deprivation. A household is considered deprived when children get sick more than twice a month—up to twice per month is considered normal (Silvaetro 2017). The under-five mortality rate in Bangladesh is high; drowning, pneumonia, malnutrition, and diarrhoea are the main reasons for child mortality (UNICEF 2008).

Third, the infrastructure dimension reflects the living quality of the urban poor. Inadequate access to safe water and sanitation, and muddy housing floors increase the child morbidity and mortality rate, which results in decreased workability and additional health costs. In addition, the use of dirty fuel—charcoals, wood, or *jute straw*—for cooking has negative implications for respiratory health, and also increases the risk of fire hazards and environmental degradation (Alder 1995; Majale 2008; Mitlin and Satterthwaite 2002). In this paper, a household is considered deprived on the infrastructure dimension if it has no

access to clean drinking water, for example from a tube well or piped water supply (see also, UN-Habitat 2016). In addition, a household is considered deprived if the household members share a toilet with members of other households, have no electricity, use dirty cooking fuel, or live on a muddy housing floor.

Fourth, the political dimension reflects the bargaining power of the urban poor and their ability to raise their voice. The livelihoods of the urban poor become vulnerable as a result of their lack of socio-political power. For example, street vendors in Bangladesh have to maintain informal relationships with local political leaders and the police to secure access to public space (Hackenbroch 2013). The urban poor use their voting rights to take advantage of politicians. For example, during elections, they use this collateral to ensure political parties fulfill their demands (e.g., access to open space, water supply, or sanitation) as middle culture actors (Hackenbroch 2013; Hossain 2006). A study on the urban poor of Dhaka showed that the majority of them work on behalf of political parties, participating in picketing during strikes, meetings, and processions (Hossain 2006). A study by Sowgat (2012) in railway slums in Khulna City, Bangladesh showed that most slum dwellers support the present political leaders so as to allow the slum dwellers to live illegally, and the majority of them rely on the political leader to minimise intra-community conflicts rather than formal administration, e.g., the police. In this paper, a household is thus considered deprived in the political dimension if none of the members has voting rights or if they do not have access to law and order, which means that they have to depend on the local political leader and musclemen for jobs and other services or to minimize arguments, which makes them more vulnerable in the long term.

Finally, spatiality, or the proximity to physical services and facilities, reflects the accessibility of the urban poor to basic services and facilities. Slum dwellers are the most disadvantaged, are poorly integrated into the broader urban society, and have fewer social opportunities than people living in formal settlements. This social exclusion and limited connectivity to the market, job centres, and government services and facilities make it very difficult for slum dwellers to do more than just survive. A household is considered deprived on the spatial dimension if the distance to services and facilities, such as school, hospital, market, water supply, and workplace,

exceeds the standard distance ( $< 500$  m for education;  $\leq 1200$  m for hospital;  $\leq 500$  m for market;  $\leq 100$  m for water supply; and  $\leq 500$  m for workplace\*) (Table 2).

### Study area and data collection

Khulna City, the third largest city of Bangladesh and located in the southwestern part of the country, was selected for this study. Nearly 20% of the people in Khulna City Corporation (KCC) (around 189,000 people) live in 520 slums and squats (CUS, NIPORT, & MEASURE Evaluation 2006). A study on slums in Khulna City highlighted “*the very large economic burden caused by poor health associated with poor quality housing and lack of basic services and how the economic cost in terms of income lost from days off work and from medical expenses was greater than the cost of improving the infrastructure to eliminate the health problems*” (Mitlin and Satterthwaite 2002, p. 11 in Pryer 1993). Fortuny et al. (2011) evaluated the status of living conditions in 29 cities in Bangladesh and found that Khulna City performed poorly (ranked 28 out of 29).

This study was carried out in six slums of Khulna City, namely, *Natun char (Rupsha)*, *Khora bosti (Hafiznagar)*, *Hafizpara (Maniktola)*, *Ispahani colony (Doulatpur)*, *Railyr bagan (Raily gate)* and *Methor potti (Jora gate)* (Fig. 1).

The slums were selected such that different tenure patterns (public, private, private freehold) are represented. The tenure pattern of the six slums is as follows: *Natun char*: public slum, *Khora bosti* and *Hafizpara*: private slums, *Ispahani colony* and *Railyr bagan*: private (freehold) company land and quasi formal slums, *Methor potti*: public (socially disadvantaged) slum. This study used a structured questionnaire for data collection through random sampling. A pilot survey was conducted in the six slums and the questionnaire was modified thereafter. A minimum of 30 households were randomly selected from each of the slums, and a total of 170 households were surveyed in 2016. The respondents were randomly selected based on ease of access, and questions were asked to the household head or an elderly person available during the survey.

**Table 2** Explanation of the dimensions and indicators

Indicators	Explanation of the indicators (deprivation = 1; non-deprivation = 0)
<i>Economic dimension</i>	
Employment	Yes = 0; no = 1
Savings	Yes = 0; no = 1
Asset ownership	Assets, such as television, mobile, refrigerator, bicycle, motorcycle, car, radio: yes = 0; no = 1
Loans	Loan for food items, treatment, marriage: yes = 1; no = 0
<i>Social dimension</i>	
Years of schooling	Completion of 5 years of schooling: yes = 0; no = 1
School enrollment	School enrollment of any school-aged child: yes = 0; no = 1
Child sickness	Child sickness more than twice/month: yes = 1; no = 0
Child mortality	Child mortality under 5 due to drowning, pneumonia, malnutrition, diarrhea: yes = 1; no = 0
<i>Infrastructure dimension</i>	
Cooking fuel	Dirty cooking fuel (wood, leaves, cow dung): yes = 1; no = 0
Electricity	Yes = 0; no = 1
Sanitation	Sanitation system (unimproved/shared/none): yes = 1; no = 0
Drinking water source	Tube well (walking distance $\geq$ 15 min) or pond/river/others: yes = 1; no = 0
Housing floor	Housing floor (dirty/muddy): yes = 1; no = 0
<i>Political dimension</i>	
Voting rights	Yes = 0; no = 1
Access to law and order	Yes = 0; no = 1
<i>Spatial dimension*</i>	
Distance to education	> 500 m: yes = 1; no = 0
Distance to workplace	> 500 m: yes = 1; no = 0
Distance to water source	> 100 m: yes = 1; no = 0
Distance to hospital	> 1200 m: yes = 1; no = 0
Distance to bazar	> 500 m: yes = 1; no = 0

\*The values of the spatial indicators were calculated using the cumulative distribution function (CDF). The value of the natural breakpoint was taken as the accepted distance. If the distance of the household from the services and facilities is greater than the accepted distance, it is considered a deprived household (deprivation > accepted distance)

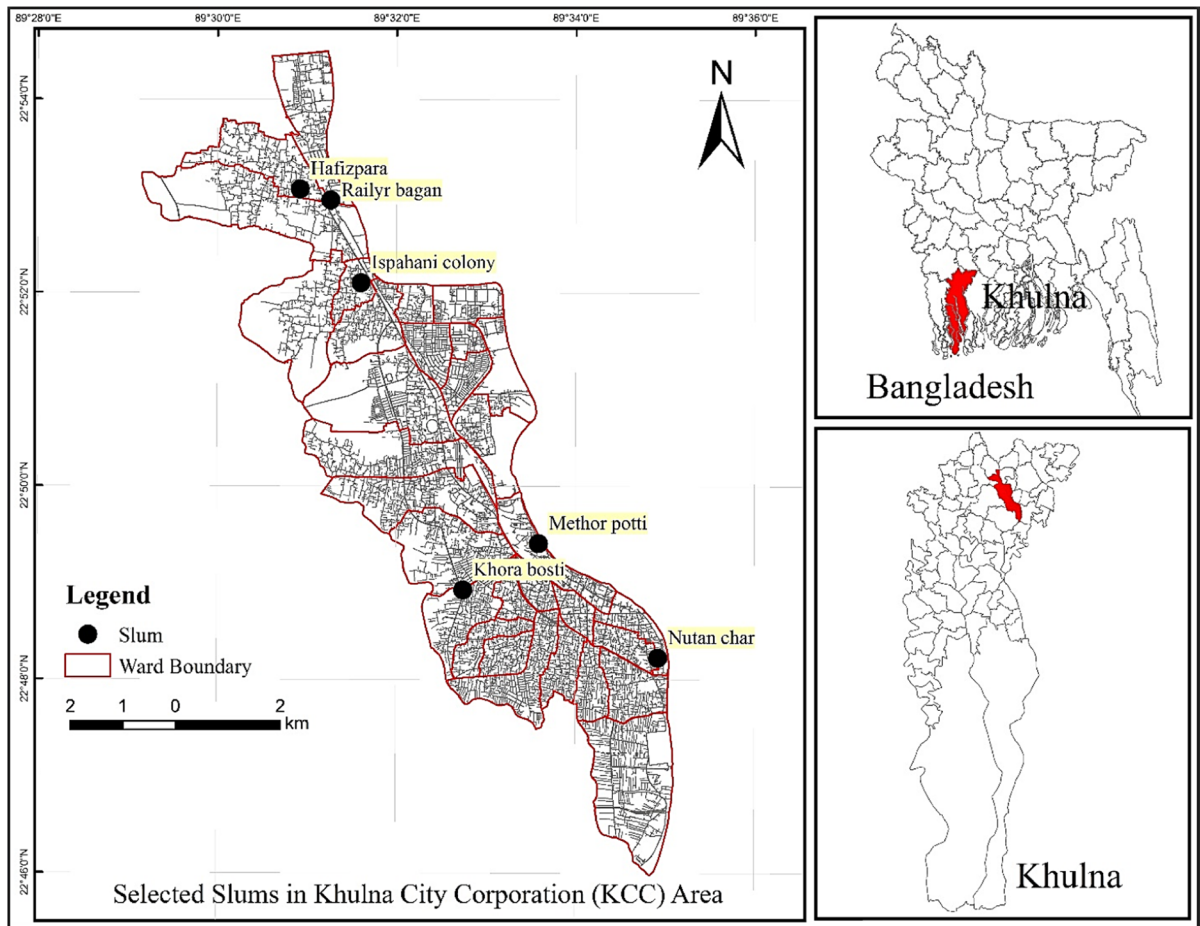
## Analytical procedure

To measure poverty, the paper first used an MPI that does not include spatiality. Thereafter, spatiality was incorporated into the MPI to observe the changes. The MPI was calculated following the AF approach stated in the Human Development Report, 2013, and involved multiple steps. After selection of the dimensions and indicators, each of the dimensions was assigned a weight. Alkire and Santos (2014) gave equal weighting to all the indicators even though they are not equally important. However, in this study, weights were assigned according to the importance of the dimensions using the analytic hierarchy process (AHP) developed by Saaty (1994). The flow chart for the development of the AHP is:

*Priority Matrix*  $\rightarrow$  *Standardized Matrix*  
 $\rightarrow$  *Consistency Ratio Test*  
 (value range 0–0.09)

*Priority Matrix* This is an  $n \times n$  matrix, where  $n$  is the number of criteria or dimensions. In this matrix, each dimension is prioritized or valued based on its relative importance compared with the other dimensions. To assign values to each dimension in the priority matrix table, 30 respondents (including slum dwellers, relevant experts working in NGOs, and university teachers) were asked to prioritize the dimensions based on their personal experience. The average answer was taken as a preliminary value (Table 3).

*Standardized/Normalized Matrix* The standardized matrix (Table 4) was found by dividing each element



**Fig. 1** Study area

**Table 3** Priority matrix [C]\*

	Economic	Social	Infrastructure	Political
Economic	1.00	1.00	3.00	7.00
Social	1.00	1.00	1.00	5.00
Infrastructure	0.33	1.00	1.00	3.00
Political	0.14	0.33	0.33	1.00
Sum	2.47	3.20	5.33	16.00

\*For four indicators, the 4\*4 matrix\*

of each column in the priority matrix by the sum of the same column. The average value of each row in the standardized matrix determines the weight (W) of each dimension.

**Consistency Ratio** The consistency of the priority values was checked by calculating the consistency ratio using Eq. 1. The outcome of the equation is

considered consistent if C.R < 0.1, highly consistent if C.R = 00, and inconsistent if C.R > 0.1. If inconsistency occurred, the results were adjusted by changing the value in the priority matrix table until the value reached a level of consistency (0–0.09). In this paper, the weights were distributed among the four dimensions as shown in Fig. 2.

$$C.R = \frac{Consistency\ Index(CI)}{Random\ Index(RI)} \tag{1}$$

where

$$Consistency\ index\ (CI) = \frac{\lambda - n}{n - 1}$$

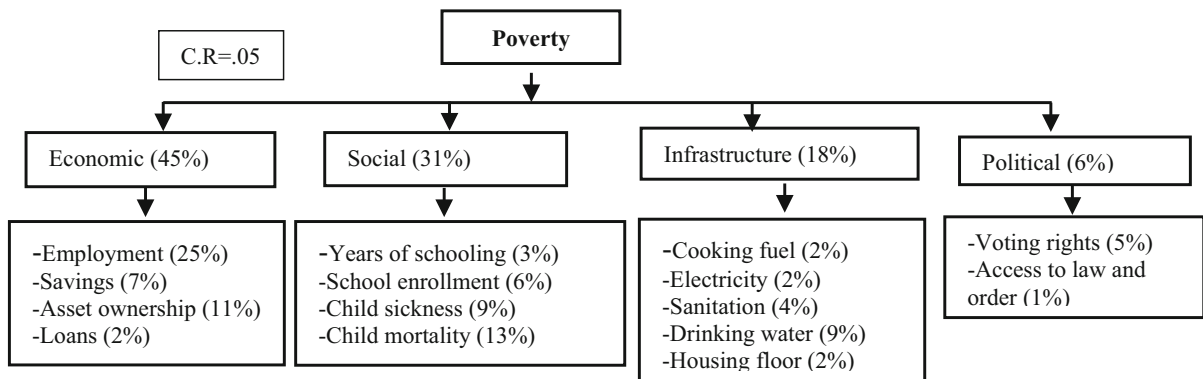
Eigen vector,  $\lambda = Average \{w_s * \frac{1}{w}\}; w_s = [c]^* w$

Random Index (RI) = Table 5 was used for the RI. For example, for criterion 4, RI = 0.90.

**Table 4** Standardized matrix (from priority matrix) and consistency ratio (C.R.)

	Economic	Social	Infrastructure	Political	Weight (W)
Economic	$\frac{1}{2.47} = 0.4$	0.31	0.56	0.44	Average = 0.45
Social	0.40	0.31	0.19	0.31	0.30
Infrastructure	0.13	0.31	0.19	0.19	0.18
Political	0.06	0.06	0.06	0.06	0.06

C.R = 0.05

**Fig. 2** Distributed weights among indicators (without incorporating spatial dimension)**Table 5** Random index (RI) (N = number of criteria)

N	1	2	3	4	5	6	7	8	9
RI	00	00	0.58	0.90	1.12	1.24	1.32	1.41	1.43

Source Saaty (1994)

The same process was then repeated to distribute weights among the dimensions and indicators after incorporating a spatial dimension (Fig. 3) to determine the impact of spatiality on the MPI.

Next, for each of the indicators, a value was assigned based on household deprivation. For example, if none of the household members had completed 5 years of schooling, the household was considered to be deprived (shown using a value of 1) and the multidimensional threshold was calculated. For example, if a household shows deprivation in three dimensions, it is considered multidimensionally poor.

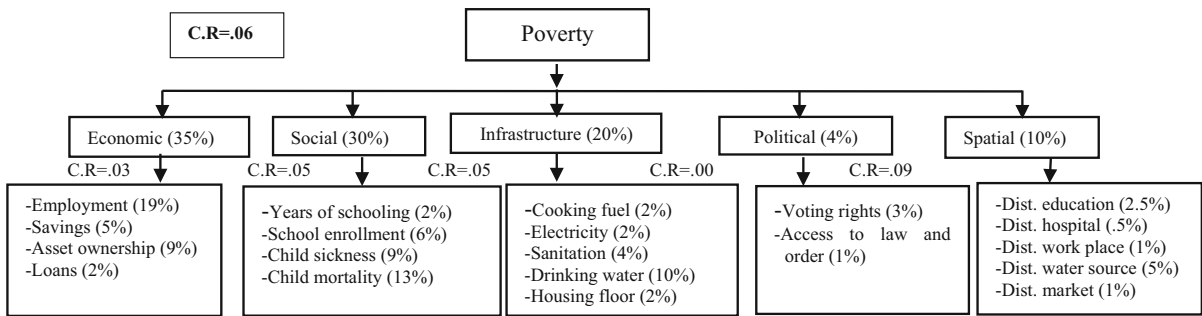
Finally, the MPI was calculated by multiplying the head-count ratio (H) and the average deprivation share among the poor (A) for the six slums in Khulna City. The procedure for this MPI calculation is shown in Table 6 using hypothetical data.

## Analysis and findings

### Comparison between income poverty and multidimensional poverty

For the MPI with spatiality, this study uses 20 indicators as the cut-off point for deprivation (cut-off point = 100/5 dimensions), and for income poverty, the cut-off point is US\$ 1.90/day (World Bank 2015). It was found that the majority of slum dwellers in Khulna City are multidimensionally poor, despite living above the income poverty line (Fig. 4). Thus, the official income poverty line does not accurately and objectively measure urban poverty. Income poverty only considers per capita income, which takes into account a household's minimum consumption cost, but fails to capture the actual deprivation of the urban poor. The slum dwellers need to spend a large share of their income on cooking fuel, housing, water, sanitation, waste disposal, and other services. Therefore, income poverty is significantly lower than multidimensional poverty among the urban poor.

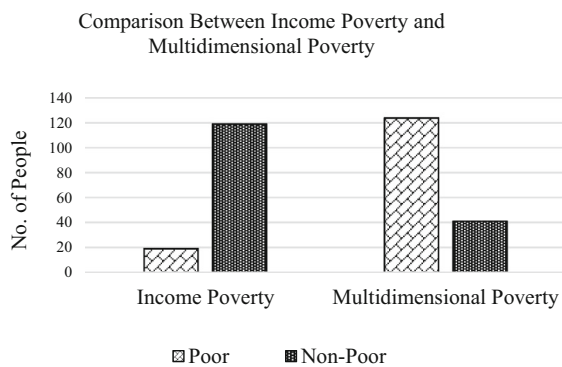




**Fig. 3** Weight distribution among dimensions and indicators (after incorporating spatial dimension)

**Table 6** Calculation of MPI (with spatial dimension) using hypothetical data

Serial no.	1	2	3	4	Weight (%)
Household size	5	4	4	5	
1. Economic dimension					35
1.1. Employment	0	0	0	0	19
1.2. Savings	1	1	1	1	5
1.3. Asset ownership	0	1	0	1	9
1.4. Loans	0	1	0	0	2
2. Social dimension					30
2.1. Years of schooling	1	1	1	0	2
2.2. School enrollment	0	0	0	0	6
2.3. Child sickness	0	1	0	0	9
2.4. Child mortality	0	0	0	0	13
3. Infrastructure dimension					15
3.1. Cooking fuel	1	1	1	1	2
3.2. Electricity	0	0	0	1	2
3.3. Sanitation	1	1	1	1	3
3.4. Drinking water	0	0	0	1	8
3.5. Housing floor	1	1	1	1	2
4. Political dimension					4
4.1. Voting rights	0	0	0	0	3
4.2. Access to law and order	1	1	0	1	1
5. Spatial dimension					16
5.1. Distance to education (less than 500 m)	0	1	1	1	4
5.2. Distance to workplace (less than 500 m)	1	1	0	0	2
5.3. Distance to water source (less than 100 m)	0	0	0	1	8
5.4. Distance to hospital (less than 1200 m)	0	1	1	0	1
5.5. Distance to bazar (more than 500 m)	0	0	0	1	2
Deprivation score (C)	21%	48%	23%	52%	
Poverty (C > 20)	Poor	Poor	Poor	Poor	
Deprivation score is 1 and non-deprivation score is 0					



**Fig. 4** Poverty comparison (income poverty vs. multidimensional poverty)

#### MPI comparison: poverty intensity (A)

Poverty intensity refers to average simultaneous deprivations. Countries with a higher headcount ratio (H) tend to have higher average poverty intensity (Alkire and Santos 2014). In terms of the MPI without spatiality (Table 7), this study shows that MPI and poverty intensity are similar for most of the slums, except *Railyr bagan* and *Ispahani colony*. Because these two slums are owned by a private company, most of the slum dwellers are employed by the company and have been living there for a long time. Therefore, these two slums also have improved infrastructures and, as a result, have a smaller number of poor households (H = 42% and 26%, respectively) than the other slums. In contrast, the number of poor households in *Khora bosti* and *Hafizpara* (private slums) is relatively high (65% and 64%, respectively). These slum dwellers use a large proportion of their income (800–2000 BDT, 20–40% of their total income) for housing and, as a result, have to compromise on their living standard. Moreover, the city corporation is not interested in providing them with services and

facilities, such as water supply, sanitation, and waste disposal facilities, owing to their temporary residency and lack of voting rights.

*Natun char* and *Methor potti* are public slums, but have significantly different MPI values to the other four slums. In *Natun char*, there is a lack of infrastructure and sanitation. In contrast, *Methor potti* is situated by the river, where the slum dwellers can get fresh air and enjoy open space, which is beneficial to their health. As a result, child mortality and child sickness in *Methor potti* is relatively lower than that in *Natun char*. However, the people living in *Methor potti* lack employment owing to their limited skills and social outcast (sweeper) status. In addition, law and order in the *Methor potti* slum is poor because the slum dwellers are not registered voters.

In this paper, we highlight slums with a variety of tenure types: public, private, private freehold. Clearly, the private freehold company slums show a better performance in the MPI than do the other types of tenure (Table 7). Lucci et al. (2018) point to the lack of slum measurements to determine the poverty differences within and among cities. Our findings suggest that there is a significant difference in slum poverty within cities, and therefore also in the poverty indicators. Tenure security provided by the private companies results in better housing and services, such as water and sanitation. Hernando De Soto (2000) emphasized the importance of formal tenure for incremental improvements of housing and settlements. Here, although the company slums do not provide a formal property system, their quasi-formality ensures enough permanency for incremental improvements to the housing and settlements. In addition to improved housing, tenure security is a precondition for public services and facilities because it gives public authorities the confidence to invest. In contrast, the infrastructure, sanitation, and service

**Table 7** MPI with/without spatiality

Slum name	Slum status	MPI without spatiality			MPI with spatiality		
		MPI*	A**	H***	MPI	A	H
<i>Natun char</i>	Public	0.24	40.67	0.61	0.33	40.53	0.82
<i>Methor potti</i>	Public	0.18	35.43	0.51	0.22	31.71	0.72
<i>Khora bosti</i>	Private	0.24	37.28	0.65	0.27	32.37	0.83
<i>Hafizpara</i>	Private	0.23	36.25	0.64	0.28	34.78	0.84
<i>Railyr bagan</i>	Private freehold	0.16	36.27	0.42	0.16	30.31	0.55
<i>Ispahani colony</i>	Private freehold	0.09	36.03	0.26	0.13	31.49	0.43

\*MPI multidimensional poverty, \*\*A poverty intensity, \*\*\*H household

**Table 8** Spatial contribution to the MPI and responsible indicators for each slum

Slum name	MPI with spatiality	Contribution of spatial dimension (%)	Spatial indicators				
			Dist. to work place (%)	Dist. to education (%)	Dist. to water source (%)	Dist. to hospital (%)	Dist. to bazar (%)
<i>Natun char</i>	0.33	24	1	3	16	4	0
<i>Methor potti</i>	0.22	22	4	13	1	4	0
<i>Khora bosti</i>	0.27	13	3	3	6	0	1
<i>Hafizpara</i>	0.28	19	2	5	5	4	3
<i>Railyr bagan</i>	0.16	15	3	3	0	9	0
<i>Ispahani colony</i>	0.13	24	6	4	6	8	0

facilities in both private slums and public/illegal squats are in poor condition.

Lucci et al. (2018) showed that the temporary nature of urban slums, which are occupied by newer migrants, means that the city authority does not feel obliged to provide them with urban services and facilities (see also IIPS and Macro International 2007). They also highlighted the political aspects of slums in urban areas. Often, politicians occupy public and private land through informal arrangements with slum dwellers that do not appear in official documents. Consequently, slum dwellers are often prevented from obtaining a city residency permit that would allow them to vote in the city elections; this thus restricts them from the city's political sphere that would ensure them public services and facilities. In *Natun char* and *Methor potti*, politicians and public authorities feel no obligation to provide these services because the slum dwellers have no voting rights.

#### Impact of spatiality on the MPI

Table 7 shows that poverty intensity (simultaneous deprivation) is more or less the same for the MPIs with and without spatiality. However, after incorporating the spatial dimension, the MPI in every slum increased. The head count ratio (H) in every slum was greater using the MPI with spatiality, which means that the number of poor households was greater than that found without spatiality. After incorporating

spatiality, it was found that every slum has some sort of services and facilities, but not necessarily within the standard accessible distance.

Table 8 shows the contribution of spatial dimension on MPI in the six slums and individual contribution of spatial indicators on poverty.

In the *Natun char*, *Methor potti* and *Ispahani colony* slums, the spatial dimensions contribute considerably more to the increase in poverty than in the other slums (Table 8). The distance to the water source is the main reason for the increase in the MPI of the *Natun char* slum and the distance to the hospital is responsible for the increase in the MPI of *Ispahani colony*. The above findings show that poverty does not only refer to a lack of income, but can also constitute poor access to basic services and facilities, for example, water, health, and education facilities.

Although there are educational facilities within 500 m of *Methor potti*, the distance to education makes a considerable contribution to the increase of this slum's MPI. This is because *Methors* (sweepers) are social outcasts and face social discrimination in the locally available public schools. As a result, they have to send their children to the railway school, which is about 2 km away from the *Methor potti* slum. Churchill and Smyth (2017) focused particularly on the importance of socio-cultural factors in determining poverty, and found that factors such as ethnic diversity and language are factors of poverty. Here, we found that intra-city slum poverty varies in Khulna, and the

*Methor potti* slum in particular is distinct from the other slums because the people living there are social outcasts. Therefore, slum development and governance policies targeting urban poverty need to be heterogeneous.

Alkire et al. (2017) suggested that the robustness of an MPI depends on it encompassing both income and non-income variables because well-being does not only depend on the monetary dimensions of life. They also suggest that a tradeoff may not always be possible between the income and non-income dimensions of poverty, and the construction of an MPI is therefore necessary for developing policies to address specific deprivations or combinations of deprivations. This study has developed an MPI encompassing income and non-income factors of poverty, and in doing so, it enables a better understanding of and comparison among intra-urban slum poverty. Bigman and Srinivasan (2002) suggest that an MPI can reduce ‘the leakage from geographic targeting’ and analysis can focus on population subgroups, such as in this case, different categories of slums.

## Conclusion

Poverty needs to be measured for better policy interventions. In this paper, the MPI of Khulna City was calculated and the impact of spatiality on poverty was explored. Traditional (indirect) poverty measures (e.g., income poverty) are unable to portray the real poverty situation, and the robustness of a multidimensional poverty measure depends on the incorporation of both income and non-income indicators because income alone cannot ensure the well-being of people. In this study an MPI consisting of five dimensions, including spatiality, and 20 indicators has been calculated and successfully used to measure poverty. This study hypothesized and confirmed that the spatiality of slums, in addition to social, economic, infrastructure, and political dimensions, is an important dimension of urban poverty. The MPI analysis showed that 42–83% of Khulna City’s slum dwellers (170 households) are multidimensionally poor and that the overall contribution of spatiality to urban poverty is 13–33%.

The MPI for poverty measurement proposed in this study has some limitations. The study was conducted on only six slums with 170 household sample surveys.

The evidence for the effect of spatiality on poverty is therefore small, and further larger studies are required to develop robust support for the role of spatial factors in urban poverty. Therefore, this study should be considered a hypothesis-testing and theory-building exercise. In addition, recent literature has shed light on other factors, such as child poverty (Short 2016), material hardship, adult medical issues (Neckerman et al. 2016), and problems with specifying poverty indicators (Alkire and Santos 2014). However, because our research deals with multiple dimensions of poverty, there is scope for the incorporation of these factors into an improved MPI for poverty measurement.

The methodology and findings of this work can be directly applied to urban development policy planning and resource distribution. Despite major interventions by the government and NGOs, urban poverty remains a major challenge for policy makers, and slum development policies often do not consider the spatial dimension of poverty. However, this study has shown that social, economic, infrastructure, and political interventions alone are not enough to reduce urban poverty. Rather, policy makers should additionally incorporate spatial dimensions and spatial interventions into slum development programs. In addition, the MPI calculation used in this study highlights the deficiencies of a particular slum; this could help to minimize the loss of budgetary resources or confirm the efficient allocation of development projects and resources.

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## Compliance with ethical standards

**Human and animals rights** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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