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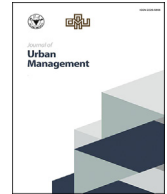
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Planning for pandemic resilience: COVID-19 experience from urban slums in Khulna, Bangladesh

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ABSTRACT

COVID-19 worsened urban slum dwellers' pre-existing vulnerabilities. Maintaining WHO-suggested physical distancing/isolation made planning more challenging in slums. The scenarios hint at the urgency to investigate whether these resource-scarce communities – already susceptible to climate change, poverty, health services, infrastructure, and space constraints, could build resilience against COVID-19. What lack of resources/assets made communities vulnerable there, and what adaptation measures were taken? What planning/management practices were adopted there, and to what extent could WHO's IPC guidelines (on transmission prevention and control) be followed? Findings show that pre-COVID economic, infrastructural, and health-related issues had affected slum dwellers' COVID-time vulnerabilities. While poor infrastructure and sanitation, informal employment, livelihood diversity, superstition, and comorbidities remained the key 'internal' issues, lack of institutional preparedness and safety-net programs, discontinued municipal services and inaccessible/untrustworthy healthcare services and corruption/bias/non-coordination in beneficiary selection remained the key 'external' issues. Information sharing, openness to pandemic knowledge, and active participation in awareness/training programs have been the most adopted measures. Aid schemes, despite criticisms, saved dwellers from starvation. Therefore, this proved to be a critical coping element. However, NGOs systematic monetary aid gave dwellers the most flexibility in spending. On top, NGOs proved to be the most vital external stakeholder in all sectors except for built environment/planning. To increase adaptive capacity, scopes remain in maximizing the use of community infrastructure in future events. Simultaneously, spatial aspects, alongside the non-spatial, seemed crucial in tackling complex poverty profiles, resource-scarcity, and vulnerabilities of slums. Findings are based on NGO BRAC's existing dataset and fieldwork between April–August 2020 on 29 slums in Khulna, Bangladesh, using a qualitative methodology. The study contributes to a growing body of knowledge and practice on resilient planning for COVID-19 (and similar future pandemics), especially for slums, while addressing its overlooked spatial dimensions.

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1. Introduction

COVID-19 took the lives of 2.9 million and infected over a 138.09 million by the first quarter of 2021 (World Meter, 2021). Compared to the 1347 Bubonic plague, 1918 Spanish Flu, SARS, MERS, and Ebola in recent years, COVID-19 has created a greater catastrophe and triggered some extraordinary situations (Nahiduzzaman & Lai, 2020). The slum-dwelling population in the developing nations, which represent one-third of the global urban population, was deemed the most vulnerable due to COVID-19 infection (Wilkinson, 2020). By mid-2020, COVID-19 was already present at Dharavi (Mishra et al., 2020), Orangi (Mamun & Ullah, 2020), and Kibera (Abuya et al., 2020; Austrian et al., 2020). It was expected that COVID-19 would only worsen their already vulnerable lives since maintaining WHO's IPC guidelines on distancing, hand-washing, or self-quarantine/isolation is almost impossible in slums (Schmidt-Sane et al., 2020).

Bangladesh has been the second most COVID-infected nation in South Asia. By January 2021, 63 of its 64 districts had already reported confirmed cases (Dhar, 2020), owing mainly to uncontrolled community transmission after the first case was reported on 8 March 2020 (Rahaman et al., 2020). As of July 2021, the total COVID-19 cases in Bangladesh were 1,022,189, with 16,419 deaths (JHU, 2021). Presently, an estimated 5.3 million people in Bangladesh are urban slum dwellers (economicsbd, 2011), with an average density of 1104 persons/km² (Rahaman et al., 2020). Pre-existing co-morbidities (Rahman et al., 2020), congested environments, inadequate WASH facilities, insecure livelihoods, and lack of knowledge in these slums (Islam et al., 2020) have increased the slum dwellers' transmission risks. In addition, insufficient testing kits (Anwar et al., 2020; Rahaman et al., 2020), human resources, ICUs, and ventilators in hospitals (Ahmed & Liton, 2020), and the overall lack of a comprehensive and coordinated pandemic management policy (Haque, 2020) have aggravated this possibility further.

Against this backdrop, this research aimed to investigate whether these slum communities – already susceptible to many social, economic, environmental, and spatial vulnerabilities, could build any resilience against COVID-19. Since the present pandemic is still in its infancy, not much scholarly work is yet available that investigates the pandemic resilience of slums. While most resilience research focuses on natural disaster-related risk/vulnerability/adaptation assessment (Woolf et al., 2016), planning research on COVID-19 emphasizes policy levels mostly (Barouki et al., 2021). They hardly address the community level, especially its spatial dimension, while available data remains scarce. Three specific objectives were therefore pursued that looked to:

1. Identify the vulnerabilities of slum dwellers amidst the COVID-19 pandemic concerning pre-COVID-19 settings.
2. Find out slum dwellers' adaptation practices in response to COVID-19.
3. Outline planning/management strategies for slums in building resilience.

Based on a literature review, the following section outlines a conceptual framework. The methodology comes after that, while the findings section addresses the first two objectives. Finally, the third objective is rejoined in the discussion section highlighting the planning/management strategies of slums during COVID-19.

2. Pandemics, resilience, and marginalized communities

2.1. Resilience and vulnerability

Holling (1973)'s socio-ecological concept of Resilience, based on nature's instabilities and dynamics, saw it as a “measure of the persistence of systems and their ability to absorb change and disturbance”. It referred to the system's ability to cope with impacts of adverse changes and shocks (Cutter et al., 2008), highlighting its ability to self-organize, renew and develop (Dhar & Khirfan, 2017), while comprising aspects like buffering impacts, bouncing back to pre-shock situation, shock-absorbing, evolving or transforming (Bene et al., 2012; Berkes & Ross, 2013; Norris et al., 2008). Two common themes qualify resilience. One, resilience is a process, not a product (Brown & Kulig, 1996; Pfefferbaum et al., 2008); two, resilience is adaptability, not stability (Handmer & Dovers, 1996; Waller, 2001).

Resilience is based on social, political, and environmental change (Adger, 2000). It signifies transformation, transformative mechanisms and adaptive capacities (Pelling et al., 2015). Transformation also associates adaptation – a process of adjustment to actual or expected adversities (IPCC, 2014). Adaptive capacity is integral to vulnerability (Gallopín, 2006; Turner et al., 2003), and they are interlinked (Jackson, 2006).

Vulnerability is the opposite of resilience. Climate change literature views vulnerability as the degree to which systems (e.g., households, communities, organizations) are prone to and unable to adapt to adverse effects of hazards (IPCC, 2014; Opiyo et al., 2014; Yunus & Kabir, 2018). Vulnerability maintains a complex relationship with individual and community resilience, whereby assets/-resources remain integral to building internal capacities against external shocks/stresses (Moser et al., 2010). Vulnerability is directly related to spatial-physical, economic, political, institutional, and governance dimensions, which decrease community resilience against hazards/outbreaks (Guillard-Gonçalves & Zézere, 2018; Hossain & Rahman, 2020).

2.2. Community resilience

Community resilience emphasizes the community's ability to endure disasters/disruptions. It is a measure of the community's physical/infrastructural (Cutter et al., 2008), socio-political (Kulig et al., 2013), economic (Leach, 2013), and psychological (Berkes & Ross, 2013) assets/resources that allow its participation during recovery. Norris et al. (2008)'s set of networked capacities, and Cutter et al. (2008)'s Disaster Resilience of Place emphasized the importance of socio-economic, institutional, infrastructural, and community

competence (Cutter et al., 2008; Norris et al., 2008). Responsible information and communication reduce vulnerabilities (Norris et al., 2008). Adaptive capacity is essential for community resilience, where human, socio-economic, natural, and physical assets work simultaneously (Mesfin et al., 2020). Berkes and Ross (2013)'s integrated approach to community resilience included values and beliefs; knowledge, skills, and learning; social networks; engaged governance (collaborative institutions); diverse and innovative economy, infrastructure, leadership, and a positive outlook, and readiness to accept change.

2.3. Community resilience and pandemic

Housing and water-sanitation-drainage infrastructure condition (Cutter et al., 2008), alongside the shortage of natural light, ventilation and unhygienic conditions directly affect COVID-19 transmission (Ghosh et al., 2020). These increase community vulnerability and challenge the inherent¹ and adaptive² qualities of resilience in high-density slums. Escalating COVID-19 cases in Dharavi (Mishra et al., 2020), Kenya, Nigeria, Pakistan (Ahmed et al., 2020), and South Africa (Desai, 2020) substantiate this. During 2009 H1N1 in Taiwan (Kao et al., 2012), and 1918 influenza in the US (Garrett, 2007), a positive correlation between higher density and outbreak/death were found.

Inadequate WASH (water, sanitation, and hygiene) facilities and practices also play a crucial role in community transmission as found in Hong Kong (Hung, 2003), while their adequacy is increasing infrastructural resilience (Cutter et al., 2008). Polluted water and poor SWM (solid waste management) also cater a higher transmission risk of COVID-19 (Mathavarajah et al., 2021). Since municipal WASH services are scarce in slums, handwashing often becomes difficult, especially without in-house provisioning (Ghosh et al., 2020). Shared sanitation facilities, including lack of waste management could become a vital source of airborne and contact exposures to SARS-CoV-2, especially in the absence of sufficient water and space facilities (Caruso & Freeman, 2020). Urban slums in this case might be at high risk due to their inadequate facilities (Corburn et al., 2020). Overwhelmed by poverty, malnutrition, and extreme health vulnerability, slum dwellers, suffer from deadly diseases (Wilkinson et al., 2020). NCDs (Non-communicable diseases) are acute in slums, as seen in Cape Town (Smit et al., 2016) and Salvador (Snyder et al., 2017). Indoor air pollution also contributes to morbidity and mortality there (Dianati et al., 2019).

Stable and diverse livelihoods and resource availability increase economic resilience (Norris et al., 2008), while solitary source dependence decreases. This was evident in Hurricane Katrina-affected New Orleans shrinking communities (Cutter et al., 2006). Lockdown restricts dwellers' movements making them lose their daily wage (San Lau et al., 2020), while lack of savings aggravating it further. Many lose up to 50% of their average wage compared to pre-COVID times (Teachout & Zipfel, 2020). Reduced economic opportunity compromise dietary quality and quantity, while the inability to home-based income complicates this further. Dwellers frequently skip meals (Zimmerer & de Haan, 2020), NFI (non-food items), and medication.

Social resilience measures communities' development and implementation of disaster-mitigation plans, sharing information, and participation in hazard-reduction programs (Berkes & Ross, 2013; Cutter et al., 2008; Kulig et al., 2013). It helps the community's recovery process (Manyena, 2006) and improves social networks within and outside the community (Cutter et al., 2008); reduced social relation decreases social values and beliefs. However, prolonged hazards increase psychological trauma, especially among the poor, often interpreted into domestic violence, where women and adolescence found as primary victims evident during Ebola (Minor, 2017) and COVID-19 (de Paz et al., 2020).

Trusted information sources are often the most vital community asset (Longstaff et al., 2005), while media, digital information, and connectivity remain invaluable (Norris et al., 2008). Trusted and transparent communication through people-centered approaches and local participation during disaster gives people more competence, accountability, and a way of reflects their values and priorities (Scolobig et al., 2015). During SARS and Ebola, many died from the lack of communication, trust, and cooperation with healthcare workers (San Lau et al., 2020). Peoples' knowledge and skills serve as safety nets and determine their resilience (Aldrich & Meyer, 2015). For COVID-19, Knowledge, attitudes, and practice (KAP) proved essential in dealing with fear, stigma, and misinformation on virus transmission in Malaysia (Azlan et al., 2020), India (Pal et al., 2020) and Nigeria (Owhonda et al., 2020).

Organizational resilience/emergency risk governance also affect community resilience (Cutter et al., 2008; Van Belle et al., 2020; Wilkinson et al., 2020), while leadership, preparedness of local authorities and emergency services enhance resilience (Leykin et al., 2016), even in situations like COVID-19 pandemic (Collins et al., 2020).

2.4. Conceptual framework

The literature review underscores the critical attributes of community resilience, with a particular focus on pandemic resilience. It highlights the role of resource ownership in improving community resilience in situations like the COVID-19 pandemic. The resources highlighted are infrastructure, socio-economic assets, community competence, and access to information. We found that emergency risk governance affects the community's resource vulnerability and pandemic-time adaptation process – positively affecting its transformation ability against vulnerabilities. Further, community resilience assumes a participatory and inclusive planning process (Masterson et al., 2014) while focusing on stakeholder identification and connections (community involvement), vulnerability assessment (physical and social capital/assets), setting goals, and prioritizing adaptation/mitigation strategies. Considering all, the proposed conceptual framework (Fig. 1) is hazard-specific, multi-scalar (cutting across the community, city, and national levels), multi-

¹ Well-functioning in non-crisis times.

² Flex-ability in response during disasters.

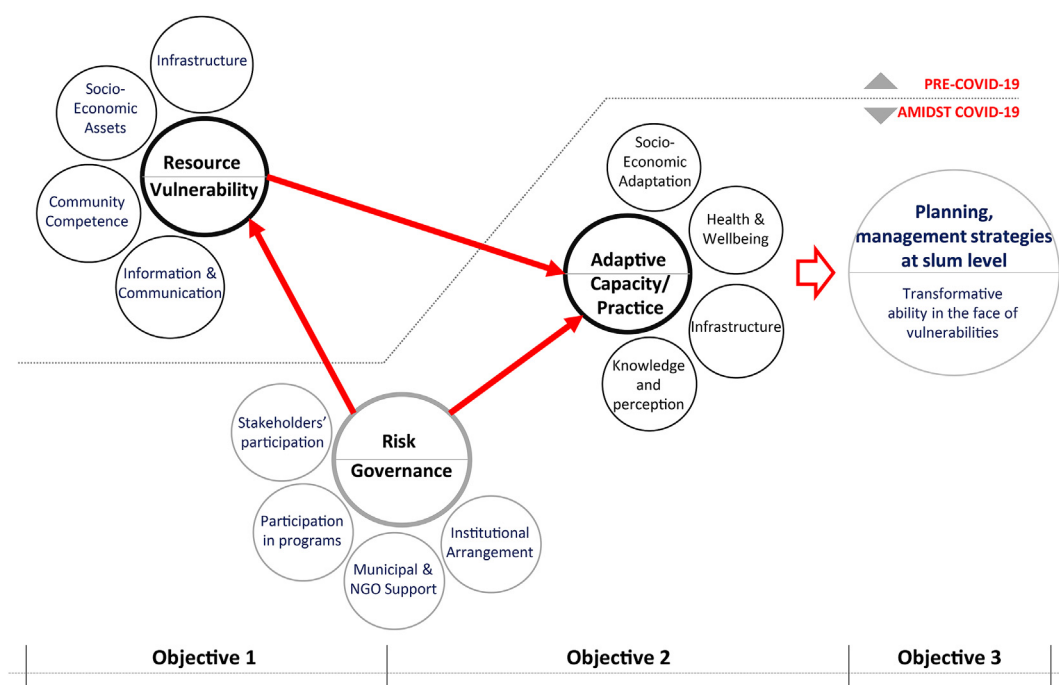


Fig. 1. Conceptual framework for resilient planning during COVID-19.

dimensional, and also time- and context-specific (as in Bene et al., 2012).

In terms of research objectives, the two key drivers of resilience – resource vulnerability and adaptive practices were assessed under objectives 1 and 2, respectively, using a diachronic analytical frame (pre-COVID and COVID-time). Although not outlined as a separate objective, the driver on risk governance laid out the backdrop against which both resource vulnerability and adaptation practices were analyzed. Finally, objective 3 outlined the planning/management strategies, synthesizing findings from objectives 1 and 2 with crucial scholarly materials reviewed.

3. Methodology

3.1. Study area

The study took place in Khulna – a low-lying coastal city in Bangladesh with about 46km² (Fig. 2). Khulna is listed among the six most climate-vulnerable cities globally (Hanson et al., 2011) and the third-largest in Bangladesh with a population of 1.5million, where 20% are slum dwellers (Roy et al., 2018). Khulna City Corporation (KCC) – the city's municipal area, is divided into 31 wards with a population density of 32,500/km². Slum-dwellers live in 1,134 slums within KCC, comprising 8.14% of its land area (BBS, 2015). Most slums are incredibly dense (550–3200persons/ha; see HAKIM, 2013: 128, 229) and have shared WASH facilities. They are characterized by poverty and unhealthy conditions (Sikder et al., 2015). The average family size here is 4.5 persons/household, living in kacha and semi-pucca houses. Households are generally male-headed, but the female assumes community leadership more. Depending on size, each slum has about 5–25 community workers/leaders who contribute to planning and improving/upgrading supported by KCC, NGOs, and donors. Four NGOs (World Vision, BRAC, NOBOL, and Water Aid) typically provide WASH support in slums, while government agencies like LGED, DPHE, and KWASA extend WASH and healthcare services occasionally.

With the assistance of KCC and BRAC, 29 slums across 17 KCC wards (Table 1) were selected based on their pre-COVID-19 data availability (collected from BRAC-UDP) and accessibility by aid workers during pick outbreak and population with reported COVID-19 infection/symptoms. The studied slums varied considerably in area and population (density). For example, the Bastuhara colony comprises about 62.72 acre of land with 768.32p/ha density, while 7 No. Ghat Bastee is only about 0.7 acre with 1430p/ha density. Greenland Bastee is the most populated (5,806), while Custom Gate Colony being the lowest (824). About 70% of dwellers are illiterate, while 80% are extremely poor without any tenure security. Interestingly, the studied slums have more female inhabitants (64.60%) than men (35.37%). About 75% of dwellers are aged between 0 and 40 years, while only 5% fall in the 60–80-year category. More than 95% of dwellers' employment is temporary. Their average income is between BDT6,000–7,000 compared to the national average is BDT26,000. The lowest was BDT4,913 at 1 No. Camp (Bihari resettlement colony), while the highest being BDT12,000 at Greenland Bastee (with more secure tenure). Typically, 15–20 households share a single tube-well and toilet (Sikder et al., 2015).

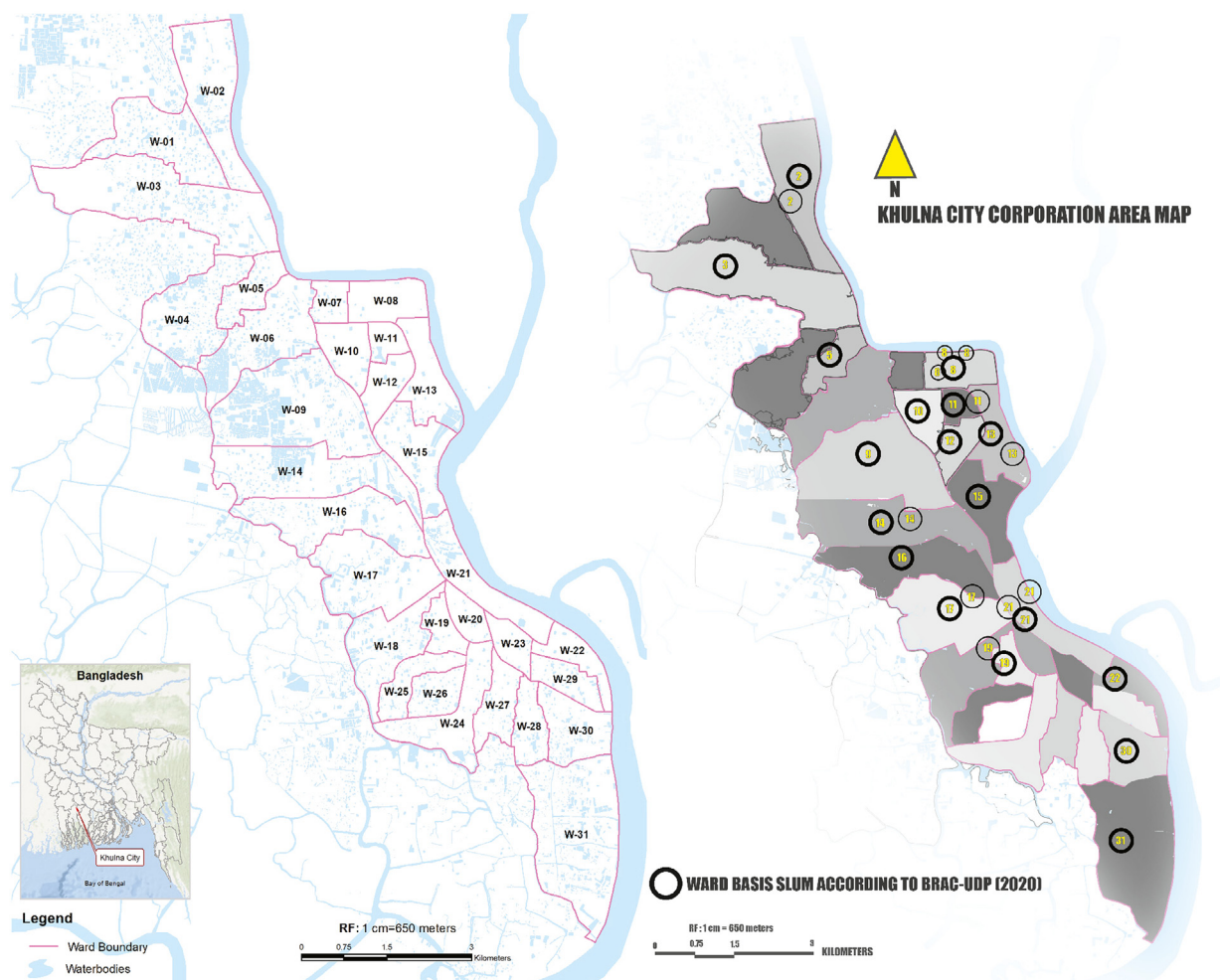


Fig. 2. (Left-inset) location of Khulna in Bangladesh; (Left) 31 wards of KCC; (Right) study slum locations across KCC wards (Source: KCC 2020, BRAC, 2020).

3.2. Research approach and data collection

This research assumes a qualitative approach combining empirical evidence with theoretical claims to produce arguments (Schwandt, 2014). The key reason for adopting this approach was comprehending slum dwellers' lived experiences (Scherzer et al., 2019) in their coping with COVID-19 extremities, as a substantial number for quantification was difficult to achieve during the pandemic.

Data collection was conducted in two phases. First, pre-COVID-19 data on slums and slum-dwellers were sourced from BRAC UDP's existing dataset on 612 households from 29 slums, collected using random sampling (Fig. 3). This helped lay out the context and identify dwellers' pre-COVID vulnerabilities. Second, COVID-time data were collected from 32 respondents across the same 29 slums and 10 external key respondents from Khulna. Snowballing was used to find slum respondents. Female dwellers were prioritized in selecting respondents. To avoid physical contact, phone interviews and web-based video call applications were used.

The drivers, aspects, issues, and dimensions outlined in the analytical framework were used for the thematic analysis of transcribed data. The key intention was to underscore the phenomenon and processes affecting these selected communities' vulnerabilities, risks, and adaptiveness during COVID-19 rather than quantifying them. To make findings measurable, an ordinal scale was used with scores for very poor (1), poor (2), fair (3), good (4), and very good (5), alongside simple "quasi-statistical" percentages without the intention to generalize (Maxwell, 2010). Scores from the ordinal scale were summarized using matrices and Radar Graphs in the discussion. This helped construct the COVID-19 resilient planning framework for Khulna slums.

Table 1
Slum and slum-dwellers profile.

SL. Nos	Slum/Settlement Name	KCC Ward	Household Nos.	Total Population	Gender ratio (%)		Age Distribution (%)			Occupation Type (%)		Household Type (%)			Average HH. Income
					F	M	0–40	41–60	61–80 Above	Parament	Temporary	Extreme poor	Poor	Not Poor	
	Ralir Bagan	2	252	1082	52	48	74	19	7	1	99	98	2		5696
	Senpara Baste	2	801	2961	70	30	74	19	7	1	99	94	6		7065
	Ispahani Colony	3	536	1874	65	35	71	21	8	2	98	99	1		5618
	Boundari Baste	5	580	2110	65	35	71	22	7	1	99	66	34		6564
	Datta Bari Baste	5	519	1735	50	50	71	19	10	1	99	81	18	1	6299
	Crescent B	8	275	837	70	30	82	15	3	5	95	27	73		8690
	Crescent Kacha	8	430	1761	60	40	68	27	5	79	21	51	48	1	4927
	Crescent Pucca	8	444	1871	50	50	78	18	4	73	27	54	45	1	9598
	Peoples Panch Tala	8	352	1099	55	45	73	23	4	4	96	80	20		5996
	Bastuhara Colony	9	1201	4818	50	50	72	21	7	9	91	61	39		6603
	Kasipur Nayabati Baste	10	867	3926	70	30	74	19	7	8	92	85	15		6555
	Platinum North	11	382	1699	60	40	70	25	5	78	22	77	23		7960
	Platinum South	11	213	919	52	48	75	18	7	85	15	78	22		8690
	1 No. Camp	12	528	2058	60	40	75	19	6	8	92	95	5		4913
	Nurani Masjid Baste	13	476	1703	70	30	73	19	9	4	96	76	24		5896
	Salermath Baste	13	509	1708	55	45	72	25	3	4	96	55	45		5996
	Custom Gate colony	14	237	824	50	50	74	19	7	7	93	70	30		9152
	Kader Sardar Para	14	289	1172	55	45	72	18	10	2	98	57	43		8000
	Alamnagar Baste	15	615	2471	71	30	74	22	4	3	97	98	2		7341
	Kalabagan Colony	16	533	2296	65	35	73	21	6	14	86	89	11		5552
	Hafiznagar Baste	17	418	1574	55	45	75	21	4	3	97	46.5	53	0.5	9389
	Moylapota Baste	17	557	2144	52	48	68	27	5	4	96	54	46		10000
	Sheikh Para Baste	19	1037	3940	65	35	74	19	7	14	86	92	8		5892
	7 No. Ghat Baste	21	833	3150	65	35	75	18	7	8	92	95	5		5610
	Greenland Baste	21	1523	5806	70	30	74	20	6	12	88	69	30	1	12000
	New Railway Colony	21	568	2339	60	40	75	19	4	33	67	86	14		8200
	Natun bazar Char	22	1014	4103	70	30	71	22	7	17	83	49	51		5850
	Sasan Ghat Baste	30	650	2498	65	35	70	23	7	41	59	59	41		8757
	Rahmania Baste	31	602	2069	60	40	78	18	4	64	36	94	6		8230

(Source: Authors based on BRAC UDP, 2020; [BRAC, 2020](#)).

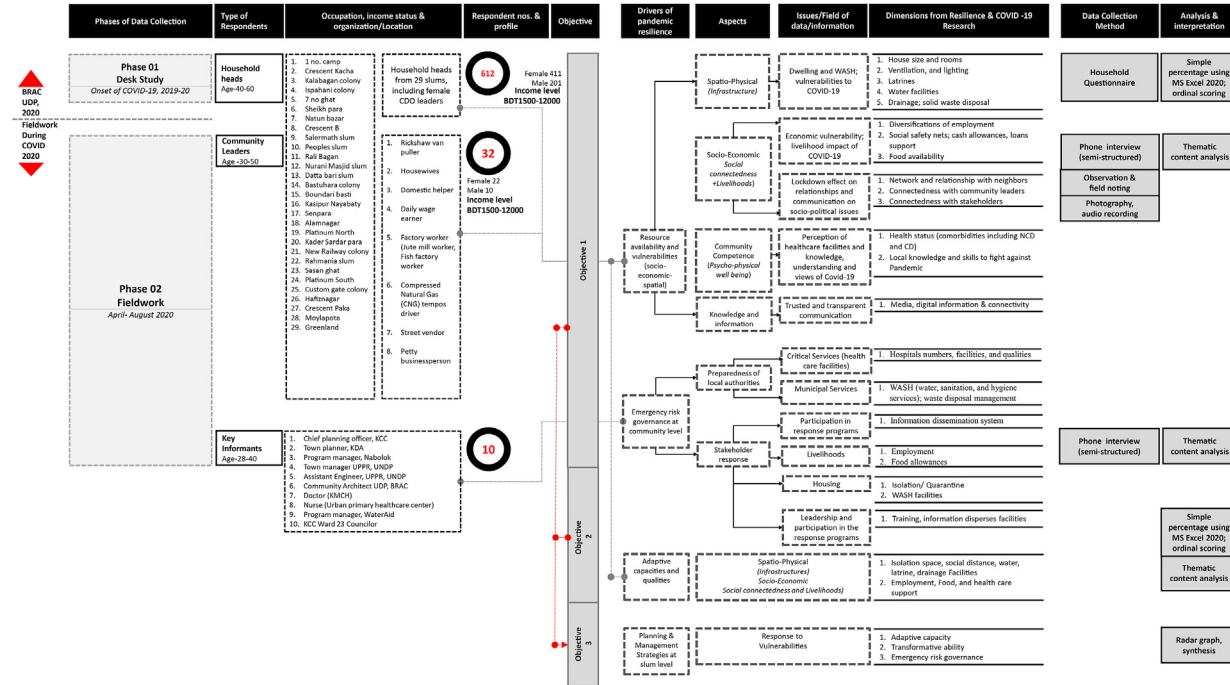


Fig. 3. Analytical framework. (Source: Authors based on Akter et al. (2021)).

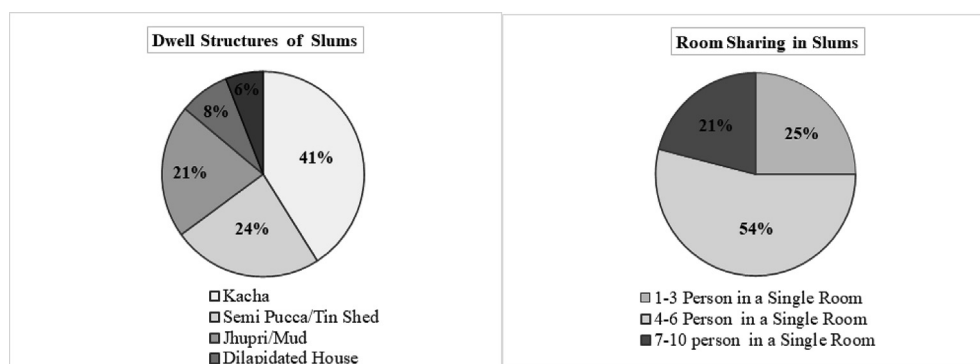


Fig. 4. Proportion of dwelling structures and room sharing practices. (Source: Fieldwork 2020).

4. Findings

4.1. Slum dwellers' vulnerabilities/resources amidst COVID-19

4.1.1. Infrastructure

Almost all dwelling units in the studied slums had an average ground cover of more than 90%. Row-organization of houses also created extremely cramped environments (Fig. 4). In addition, 1–1.25 m narrow streets produced inadequate indoor lighting and ventilation conditions (Fig. 6A), while openings could not be provided without any setback space. This made the WHO (2020)'s mandatory air-change guidelines impossible to maintain. Typically, a 4-5person family occupied space as small as 9.29–13.24³sqm. Slum occupants suffered from the settlement's low elevation, monsoon flooding, water logging, and difficulties maintaining non-permanent/Kacha buildings. More than 5% of studied slums seemed more concerned about seasonal (e.g., about 80% of all rains are falling from May to mid-October in Bangladesh) rainfall than Coronavirus. For instance, Rahmania Bastee, Natun Bazar Char, and Datta bari bastee presented their worsened situation during monsoon rain, while neighborhood drains become blocked with rainwater and household waste.

With scarce in-house space and financial means, toilets/baths, and tube-wells (subsidized by NGOs) remained under group/community ownership. About 90% of slum toilets/baths and tube-wells were shared. Deep tube-well/boreholes (53%), piped water in dwells (9%), and public taps/stand posts (7%) were the most common water sources (Fig. 5). However, some also used unsafe water at *Kashipur Nayabati* (45%) and *Natun Bazar Bastee* (55%), by collecting arsenic-contaminated water from shallow tube wells.

Generally, the spatial organization of slum infrastructure was uncondusive to maintaining social distance. Often as high as 16-30households shared a single toilet/bath, while 25–30 shared a single tube-well. At '*Ralir bagan*', only 08 latrines existed for 1,074 residents. A *Natun bazar* resident spoke:

"The lanes are so narrow that we can barely cross each other; we rub shoulders... We need to travel outside to use common toilets... It is hard to maintain quarantine as we don't have sufficient space and lack (attached) toilets ..."

Typically, 130-150people queue at least twice a day at the very tight shared WASH yards (Fig. 6B), creating a transmission hotspot. During the lockdown, latrine usage increased significantly, as dwellers queued about 20 min compared to pre-COVID 10 min. During peak hours (morning and noon), they queued for even 25 min. Naturally, NGOs and aiders install community tube-wells, taps, and toilets in available empty spaces along the streets, often without considering (travel) distance and time for all users, let alone COVID-19. For instance, at *Natun Bazar*, 35% of dwellers typically travel 100 m or more to avail drinking water, while tube-wells were typically installed within 10 m of latrines (Fig. 6B). Therefore, it was felt that distance/time and location issues were quite precarious there, as these increased chances of contact. In many slums, hand-wash points could not be found within 5 m of toilets – contrary to WHO IPC.

In all slums, most household human waste/water was disposed into open drains. Floating human excreta were seen even in *Green land Bastee* (Fig. 6C) – one of the better serviced in Khulna by KCC. Most children were found using a toilet/tube-well yard for defecating. Although KCC is responsible for citywide SWM and WASA for FSM, they seldom perform these in slums; neither does any NGO. During the lockdown, even such scant efforts stalled completely (Fig. 6D).

4.1.2. Socio-economic status

Slum dwellers' 'poor' economic status owed mainly to their almost complete dependence on informal sector (non-permanent) jobs and non-diversified income sources. Most dwellers were daily wage earners, while their average income ranging between BDT6,000–8,000 (Table 2). 70% of respondents had no savings; their expenditure almost always exceeding their income. Dweller spent their 60% income on food (Fig. 7), while 50% typically starved once a month. Home-based enterprises (HBE) like running small groceries, raising poultry, and sewing/embroidery were the key livelihood sources for 30% of dwellers. These helped them cope during the

³ According to Sphere handbook 4.5 sqm for per person livable area.

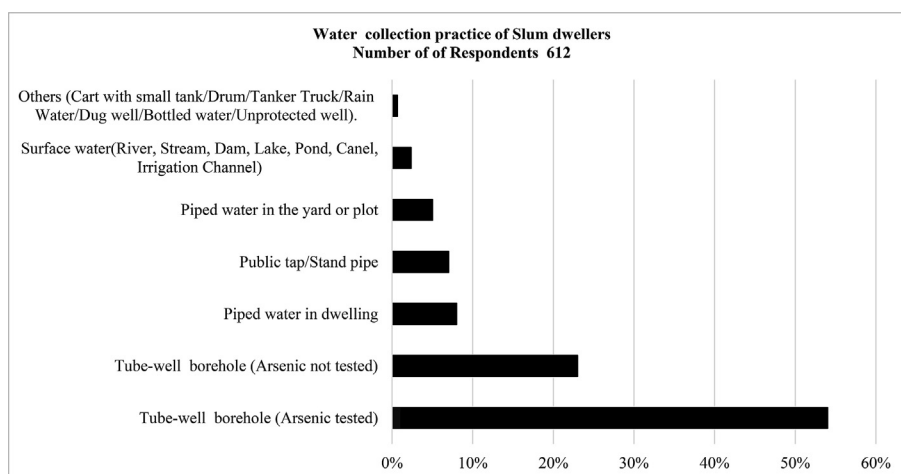


Fig. 5. Water collection sources. (Source: Fieldwork, 2020 and BRAC, 2020).

pandemic.

During COVID-19, the unavailability of food items and price hike directly affected dwellers' access to primary/staple food. Most failed to store food as bulk purchasing was unaffordable. Only near about 1% had enough savings to store food beyond 4 months, while about 34% saved enough for 2–4 months (Fig. 7). Usually, dwellers purchase food in small quantities from neighbourhood groceries/hawkers in credit. Due to lockdown, the latter, being poor themselves, stopped credit and/or ceased business. These made dwellers rely solely on aid. A Bastuhara resident said,

"During COVID, my problems worsened...stuff that I purchased for 20BDT/kg now cost BDT40. People have no income (now), but prices are high, and we cannot afford food to remain healthy".

Households suffering from multiple comorbidities, having disabled/elderly members, or requiring special care proved to be the worst (food) vulnerable during COVID-time. Nearly 60% of female-headed households suffered from food shortages compared to 20% male-headed ones. Children took consecutive "rice and lentil" meals. A mother of four from 1 no. Camp spoke:

"My children have been suffering for healthy diet during CORONA time. They have been crying for meat for last two weeks, but I could not afford to buy..... So, I bought eggs and cooked with heavy spices, so that they even got meat flavor."

Staying home during COVID-19 intensified gender violence. Losing livelihoods, uncertainty, and financial hardship incited domestic violence, as women and girls became subject to physical and psychological violence in about 20% of households.

During the outbreak, dwellers' social capital, the most critical livelihood resource for the urban poor – often more useful than financial or physical resources, was adversely affected. About 70% of dwellers were willing to feed/lend their impoverished neighbours during hardship despite poor themselves. Yet, in 80% of cases, dwellers became highly suspicious of disclosing symptoms even to their neighbours. Limited knowledge of COVID-19, misconception and fear of isolation and stigmatization made them conceal the truth, lie to neighbours, or force them to leave slum.

In aid distribution, DC and KCC were often biased and nepotistic. About 20% confirmed that voters of the ruling party and those having close ties with 'leaders' were privileged/prioritized. Regarding NGO aid, one respondent informed,

"Only those identified as extremely poor are receiving aid...But there are also many 'very poor' households who were not listed".

4.1.3. Psycho-physical wellbeing

Community competence scored 'poor' in terms of psychophysical well-being; about 60% of slum dwellers were found with pre-existing comorbidities. Diarrhea, malaria, skin disease, tuberculosis, and diabetes had been their common infectious diseases (Table 3), while high blood pressure was the most critical non-communicable disease. Anemia and malnutrition were also found among 70% of dwellers, especially women and children. Despite reported morbidities, COVID-driven mortality was relatively low (about 350 persons during fieldwork); only about 20% of dwellers have, at some point, demonstrated three symptoms (fever, cough, and pain).

Illiteracy also hindered learning about WHO guidelines properly. Religious confidence, cultural principles, and misconception had their influence on knowledge and awareness of COVID-19 too. For example, about 80% of respondents held that "Allah would keep us safe," as 70% considered COVID-19 as "Boroloker rog" – a disease of the rich. More than 33% believed that COVID-19 is Allah's punishment to the corrupted and rich people; communal prayer, dua (religious hymns), and chanting should safeguard them.

In terms of treatment, 60% of dwellers in home isolation devoted themselves to prayer, Quran recital, and dua and took home remedies. They also purchased flu medicine from local pharmacies and saw Kabiraj (traditional quack). However, due to unaffordability, some even refrained from taking any medication at all.



Fig. 6. A) Lack of lighting and ventilation in house interior; B) Unhygienic location of shared tube-well and toilet; C) Open-drain with disposed of garbage; D) Almost full solid waste bin; E) Slum dwellers' hand-wash practice; F) CI sheet built makeshift toilet. (Source: Fieldwork, 2020).

Table 2
Slum dwellers' income-level.

Monthly income (BDT)	Percentage (%)	Number of respondents	Occupations
1500–4000	6	36	Maid/Domestic helper (DH), Beggar (B)
5000–6000	2	10	Sweepers/Mason
7000–9000	44	271	Street vendor (SV)/Hawkers (H), Small businessmen (SB), Day labor (DL)
9000–10000	39	240	Fish factory (FF), Rickshaw puller (RP), Service holder (SH)
11000–12000	10	55	Driver (Auto Rickshaw)
	100%	Total (N = 612)	

(Source: BRAC UDP, 2020).

4.1.4. Information and communication

TV and radio were the most reliable media for receiving COVID-19 information and keeping updated. 50% reported that obtaining information from friends, family, or neighbors was more helpful than the internet (2%). In contrast, NGO-managed information delivery systems (e.g., miking, meeting, infographics etc.) were more helpful than the rest. About 70% of dwellers had the slightest understanding of quarantine and isolation. Misperception and misinterpretation of transmission of COVID-19 often turned into rumours and spread quickly across settlements. Many held that touching dirty objects or dust could infect them.

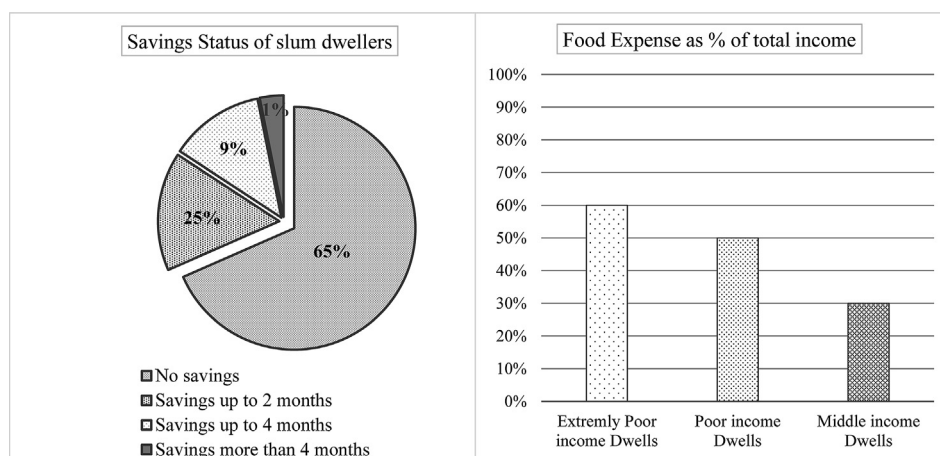


Fig. 7. Savings status and food expenses of slum dwellers. (Source: Fieldwork, 2020).

Table 3

Health condition and disease classification.

Disease classification	Common health conditions	Percentage (%) of Respondents
Non- communicable diseases (NCD)	Stroke/Heart-related issues	80
	Hypertension/High blood pressure	70
	Diabetes	60
	Drug addiction	55
	Gastric problem/Ulcer	40
	Obesity	35
	Arthritis/Bone weakness	30
Communicable diseases (CD)	Cough/Tuberculosis	70
	Fever/Malaria	60
	Food poison/Diarrhea	60
	Measles/Skin infections	50
	Cholera/Waterborne disease	40
	Hepatitis	30

(Source: BRAC UDP, 2020).

4.2. Emergency risk governance

4.2.1. Institutional arrangement

No medical support program (government- or NGO-supported) was dedicated to Khulna slum dwellers following the COVID-19 outbreak. Although two Government hospitals (*Sadar Hospital and Medical College Hospital*) were there, both lacked personnel, equipment, and accessories. Hospitals got overwhelmed by sudden demand hikes for beds, and proved less prepared due to inadequate transmission prevention, hygiene and waste management, unequipped ICUs (e.g., without unfavourable pressure rooms), and ventilators. Only 02 ICUs and 18 beds were available for the 10 million people of Khulna division. 10 beds were later shifted to *Diabetes Hospital*, which had faulty equipment and inadequate medical supplies. Hospitals had neither SARI (*Severe Acute Respiratory Infection*) treatment facility nor any *Triage* as per WHO's IPC.

Respondents lost faith in the overall healthcare management system after rumours spread about the lack of patient management and isolation facilities, faulty PPEs, and facemask shortage. In addition, 80% complained about nepotism, bribery, and political influence in sample collection, testing, and managing hospital seats. Hence, they became doubtful and even reluctant to get tested. For most, government-imposed COVID-19 testing fees became a burden at the later stages.

Once NGOs and Government organizations stopped providing free masks and soaps, 95% of dwellers stopped using them. Despite having symptoms, even purchasing a mask-box for as low as BDT500 (USD 6) proved unaffordable. Some, however, purchased low-quality masks while others made their own masks. NGO-run community clinics also remained closed, alongside vaccination, reproductive, maternal and child health programs. This made the pregnant women and physically challenged even more vulnerable. A leader from *New Railway Colony* demanded,

“We need emergency medical care for the pregnant; doctors are no longer seeing them ...”

4.2.2. Municipal/NGO support

Dwellers rated KCC's COVID-time municipal service as ‘poor’ since all SWM and drain-cleaning services ceased. UNDP, which works in physical upgrading alongside BRAC, did not do much either. Efforts of NGOs like NOBOLK and Water Aid remained limited to

Table 4
Summary of aid schemes.

Aid provided	Categories and quantities of Aids	Aid agency
Food Items (FI)	Rice (60 kg), lentil (1 kg), salt, flour (2 kg), edible oil (1 L), Sugar (1 kg) Pulses and Potatoes (2 kg)	Governmental agencies; KCC Mayor; Councilor office, NGOs Governmental agencies; KCC Mayor; Councilor office
Non-food items (NFI)	2 pieces of soap and 1-1/2 kg detergent powder (disinfectant liquid) Water storage containers and paddle basins Tissue paper Surgical Mask	NGOs; CDC NGOs NGOs NGOs
Financial support	Cash	Governmental agencies; KCC Mayor; Councilor office; NGOs

(Source: Fieldwork, 2020).

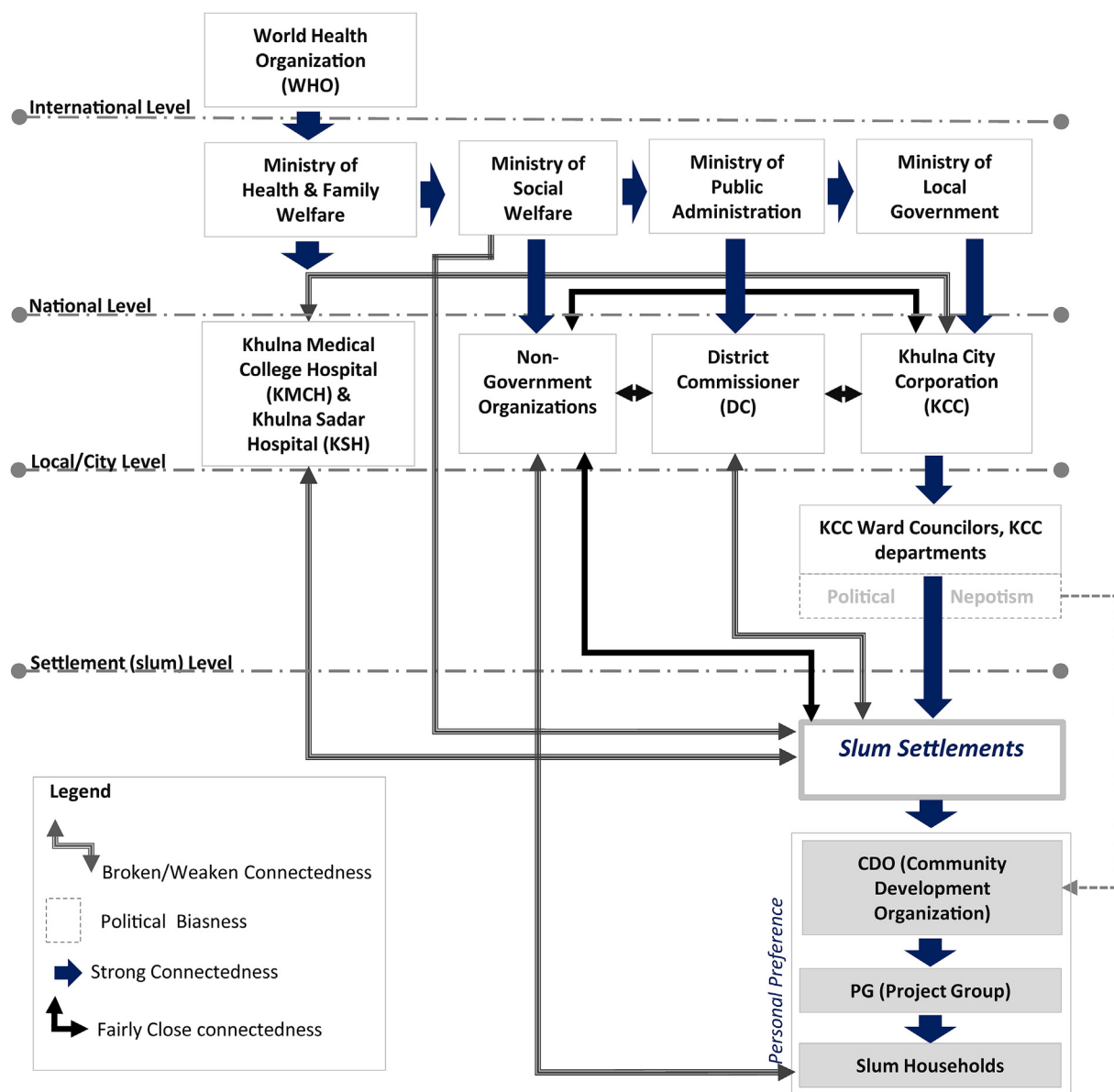


Fig. 8. Interrelation among slum dwellers and all stakeholders during COVID-19. (Source: Fieldwork, 2020).

provisioning sanitation kits and paddle-type hand-wash stations in about 1% of slums (e.g. Greenland) and conducting various support/awareness-raising programs. No effort toward making/managing a healthy built environment was visible. Neither KCC nor NGOs helped

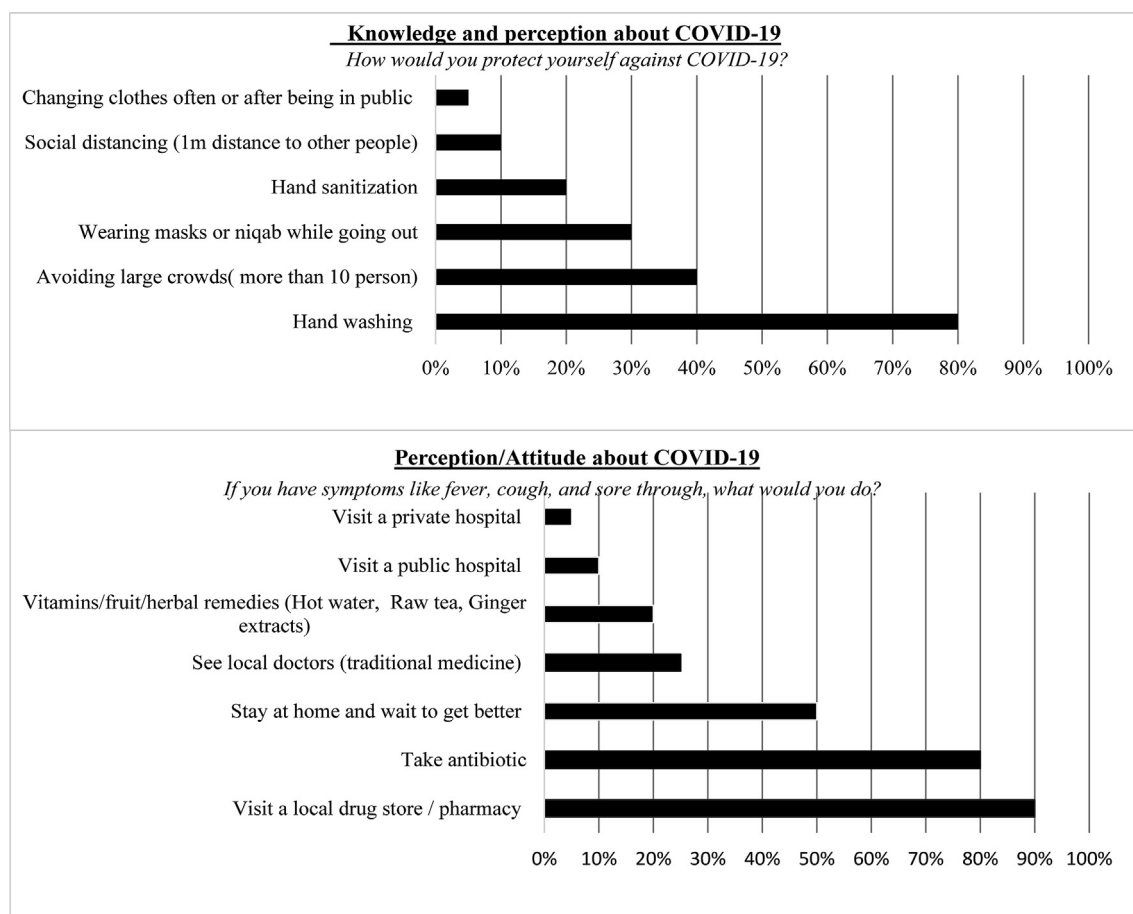


Fig. 9. KAP during COVID-19. (Source: Fieldwork, 2020).

communities reorganize their indoor spaces in the likely case of isolation, improve indoor lightning and ventilation or improve community transmission-prevention infrastructure/facilities.

4.2.3. Participation in response programs

Male-female participation in various pre-COVID programs in Khulna slums is about 1:10. Female dwellers are proven community leaders, participants, and volunteers here. During the last two decades, UNDP's UPPR and other NGO programs produced 5–25 female leaders in each slum. So naturally, COVID-19 management was female-focused and female-led. For better management of COVID-time aid, NGOs formulated one project group for every 20–25 households; these were also female-headed. For awareness raising, women were first trained about COVID-19 and later on household-level preventive measures. For BRAC and NOBOLK, female leaders circulated information among households (1 for every 20 households) and helped identify the vulnerable.

4.2.4. Aid distribution/management

Slum-dwellers received various aid during the outbreak period (Table 4). KCC Mayor frequently visited these slums during May–July 2020 and paid BDT100/person regardless of households' poverty levels. The latter also received BDT2,500/person from the Prime Minister as part of an aid program for 5million most vulnerable families across Bangladesh. Yet, about 40% of dwellers could not avail of this due to non-registered cellphone ownership and local-level corruption in beneficiary selection. Despite KCC, DC, and NGO efforts in distributing food and NFI, no long-term planning was conceived – neither at the Urban/Ward level nor at settlement level to adapt to similar economic shocks arising from lost livelihoods. Aid was distributed without any clear guidelines especially targeting the most vulnerable. No credit provision was created from the government side to make monetary resources available swiftly and flexibly at the onset of the early COVID-19 period (March–June 2020).

In contrast, BRAC's aid scheme, although limited, carefully assessed individual household's poverty-level/needs (based on households' monthly income below BDT5000) and identified the most vulnerable. It disbursed BDT1,500 for 4-member households for two weeks. Owing to such researched and targeted approach, households could plan their spending better by pooling/managing available resources.

Although District Coronavirus Prevention Committee (chaired by Khulna DC)'s regular efforts on-ground and online, a general lack of coordination between Hospitals, NGOs, DC and KCC became apparent in COVID-19 management. KCC and its *Ward Councilors* also acted

Table 5
Summary of Vulnerability, Risk Governance, and Adaptive capacities during COVID-19.

Drivers of resilience	Aspects/issues	Dimensions	Vulnerability level (in different slums)	
			Very poor	Poor
			1–1.99	2–2.99
Resource availability/ vulnerability	Infrastructure & sanitation	House size, space availability	All slums	
		Ventilation & lighting	All slums	
		WASH	26, 27	Remaining slums
	Social	SWM	All slums	
		Social network & relationship		
	Economic	Connectedness	Remaining slums	
	Community competence	Social safety nets; support		All slums
		Employment & food security		
	Information & communication	Health status	All slums	
		Local knowledge & skills		All slums
Drivers of resilience	Aspects/issues	Dimensions	Vulnerability level (in different slums in accordance with the slum serial nos. written in Table 1)	
			Very poor	Poor
			1–1.99	2–2.99
Emergency Risk Governance	Critical physical health care facilities	Hospitals numbers, facilities, & qualities	All slums	
		Municipal Services		Remaining slums
	Stakeholder's response (livelihoods & housing)	WASH & SWM, isolation/quarantine facilities		All slums
		Employment & food security		All slums
Drivers of resilience	Aspects/issues	Dimensions	Adaptation level (in different slums in accordance with the slum serial nos. written in Table 1)	
			Very Poor	Poor
			1–1.99	2–2.99
Adaptive capacities & qualities	Infrastructure	WASH, SWM, housing cond., isolation/quarantine facilities		All slums
	Economic	Employment & food assurance	Remaining slums	20, 23, 27
	Social	Social connectivity & networks		
	Health & well-being	Healthcare services & facilities		Remaining slums
		Health care knowledge, practices, and attitudes		

nepotically in beneficiary selection, even though KCC-NGO nexus was reported to be the most effective in aid distribution. Generally, KCC's healthcare services did not perform well. It did not have much control over Hospital management; neither KCC's contingency department (responsible for drainage/garbage collection) nor the health department played any significant role in ensuring necessary health/sanitation services in times of need. Initially, Khulna DC failed to secure testing and support from public hospitals under his jurisdiction. A severe shortage of test equipment/kits describes this period. The Ministry of Health could not supply these in time due to supply-demand mismatch, ministry-level corruption, and preparedness. Moreover, the safety net programs by the Ministry of Social Welfare did not cover 95% of dwellers also. However, line ministries for KCC (Ministry of Local Government) and DC (Ministry of Public Administration) coordinated well in ensuring inter-ministerial support and maintained robust connectivity.

Despite claims of nepotism and political rivalry, slum dwellers and local *Ward Councilors* maintained their relations. Ward Councilors' desire for popular support to win elections, retain power and warrant legitimacy was well complimented by slum dwellers' necessity to access services and resources (and aid/relief). This proved quite vital during COVID-19. In this relationship, CDO (Community Development organization) leaders acted as intermediaries, while PGs (project groups) connected individuals/households to CDOs.

Vulnerability level (in different slums)			Effect Level	Factors in vulnerability-level variation	Overall aspect-wise vulnerability	Driver-wise vulnerability
Fair	Good	Very good				
3–3.99	44.99	5–5.99				
1, 5, 25			Individual	Density, financial support, lack of NGO & local government support	Very poor	Poor
All slums			Individual			
All slums			Individual + Community			
6,17,18, 21,22,25, 26,28,29	7, 8, 12, 13		Individual + Community	NGO contribution to leadership; connectivity	Fair	
			Individual + Community	Informal/temporary employment	Poor	
			Individual	Lack of employment diversification		
			Individual	Comorbidities	Poor	
			Individual + Community	Religious & cultural practices		
All slums			Individual + Community	NGO contribution; media, social relation & network	Fair	
Vulnerability level (in different slums in a concordance with the slum serial nos. written in Table 1)			Effect Level	Factors in variation	Aspect-wise risk	Driver-wise risk
Fair	Good	Very good				
3–3.99	4–4.99	5–5.99				
1, 25			Individual + Community	Lack of national-level policies, integration & management	Very poor	Very poor
			Individual + Community	Lack of emergency response mechanism	Very poor	
			Individual	Favoritism, ill-managed aid distribution; livelihood diversification lacks	Poor	
			Individual + Community	Scarcity of space, affordability, and support	Poor	
All slums			Individual + Community	NGO roles; women's motivation/initiative	Fair	
Adaptation level (in different slums in accordance with the slum serial nos. written in Table 1)			Effect Level	Factors in adaptation-level variation	Overall aspect-wise adaptation	Driver-wise adaptation
Fair	Good	Very good				
3–3.99	4–4.99	5–5.99				
6,17,18, 21,22,25, 26,28,29	7, 8, 12, 13		Individual + Community	Density & facilities ratio	Poor	Fair
			Individual	Permanence of employment, pensions, diversification & social safety nets	Poor	
	All slums		Individual + Community	NGO contribution to leadership; connectivity	Fair	
1, 5, 25			Individual + Community	Lack of facilities, and comorbidities	Poor	
All slums			Individual + Community	Lack of education & practical knowledge	Fair	

However, despite Khulna DC's use of an online aid registration system, slum dwellers could hardly reach his office in case of emergencies. Similar happened when dwellers required healthcare support from government hospitals. Only the NGOs kept providing everyday and emergency supports. Fig. 8 highlights this interrelation and identifies weak and strong connections among dwellers and all stakeholders/actors during COVID-19.

4.3. Adaptive capacity and practices

4.3.1. Socio-economic adaptation

About 60% of dwellers assumed the following three coping mechanisms to make up for disrupted livelihoods: (1) borrowing from friends, relatives, or loan sharks starting from April–May 2020; (2) selling household items; and (3) relying on aid. About 90% dealt with the worst food crisis during May–July. About 60% of households reduced meal portion size, skipped meals and relied on low nutrition meals. In addition, 5% sold out household items to afford food-related expenditure and banked on the limited aid from KCC and NGOs.

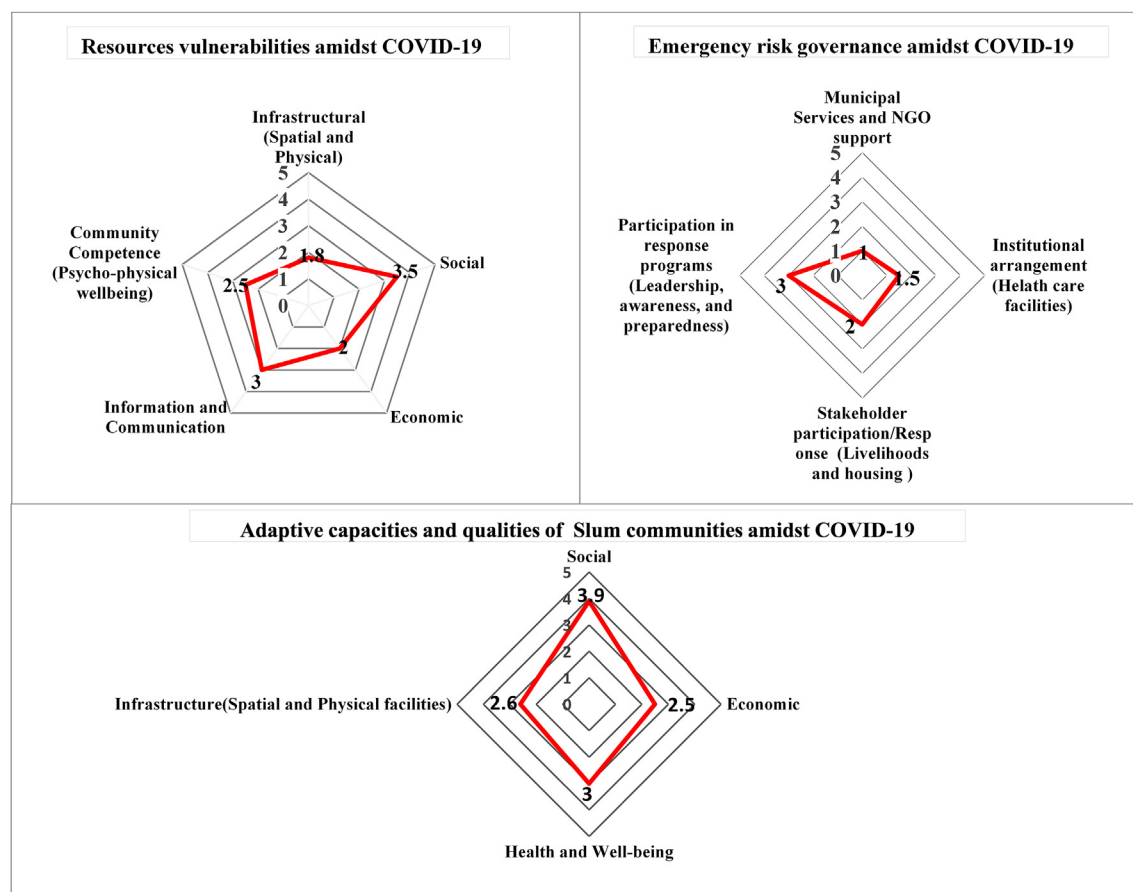


Fig. 10. Slum dwellers' pandemic vulnerabilities, organizational risk governance, and adaptive capacities. (Source: Fieldwork, 2020).

Dwellers stored dry and staple food (e.g., rice, potato, and oil), but storage quantity differed based on their financial capability. A community leader from *Greenland* informed that she stored 20 kg of rice and dry food to feed her family for a month. Others suggested that 60 kg of rice helped them survive about 4 months. About 65% of dwellers, including beggars, domestic helpers, and hawkers, failed to stock any food – making them skip meals repeatedly.

Almost no skill development program was reported by respondents to create alternative livelihoods and enhance their resilience to future pandemics. Only very few dwellers (0.1%) in *Crescent Pucca and Crescent Kacha, Natun Bazar, Moilapota, and 1 No. Ghat* received some saplings and training in urban agriculture through BRAC. The most detrimental practice adopted by dwellers was sending children to work (Domestic helpers mainly). This number increased threefold compared to pre-COVID times. Some also sent their adolescent girls to early marriage, as the boys' family received a dowry.

4.3.2. Health and wellbeing

The most encouraging outcome of COVID-19 was probably dwellers' adaptation to hand-wash as a regular habit (85% compared to the previous 10%) (Figs. 6E and 9). Lack of face-mask forced female dwellers to use their scarves/shawls or niqab as a method of IPC of COVID-19, which is against the WHO's recommendation. Without soap and hand-wash liquids, dwellers used ash – adequate but not certainly conforming to WHO's IPC. In both cases, NGO-led health programs played a significant role. Although such programs were insufficient, the dwellers' awareness level certainly enhanced.

4.3.3. Knowledge and perception

As respondents acquired firsthand knowledge on COVID-19, and they showed positive attitudes on the benefits of handwashing (80%), staying home (50%) and avoiding crowds (40%) for successful transmission prevention (Fig. 9). 90% of them held that taking antibiotics would cure them of infection while seeing local (traditional) doctors were better than visiting hospitals. 80% of dwellers rightly identified person-person contact as the key source of virus transmission, while only 20% realized that social distancing was essential (Fig. 8). Coughing, Soaring throat, and reducing olfaction were recognized as the main reasons, while surface-person contact was deemed least accountable for transmission. 80% understood this outbreak as 'mohamari' (pandemic) and 'choyache rog' (transmissible disease). About 50% of dwellers were found who, despite knowing COVID-19, did not follow any preventive/protective measures due to unaffordability, illiteracy, and lack of healthcare facilities.

4.3.4. Infrastructure

Despite 50% of slums have some form of community spaces (e.g., schools, meeting rooms, etc.), neither NGOs nor dwellers came forward with the idea of using these for COVID-19 management. *Notun Bazar* and *Greenland* slums later began considering the use of their empty schools for meetings and quarantine. Yet despite successful NGO supports to upgrade WASH infrastructure for the past 04 decades, most have been ‘need-based’ and sectorial. These failed to foresee a crisis like the COVID-19 pandemic. In the scarcity of toilets, baths, and water supplies, only 10% could afford to build makeshift attached toilets (Fig. 6F). For this, they had to borrow from family and friends in the absence of NGO or government assistance/loan/subsidies. In 40% of households without such facilities, female dwellers reduced water intake to avoid trips to community toilets.

For isolation, 80% of people preferred home isolation, similar to the 40 infected/reported people at *Greenland* who got treated at home. To manage this, dwellers had to divide their only room (11–15sqm), using temporary partitions like saree, quilt, or furniture. Some bigger houses adopted a new furniture layout but completely compromised lighting and ventilation.

5. Summary and discussion

Table 5 and Fig. 10 illustrate Khulna slum dwellers’ ‘poor’ pandemic resilience. Although they ranked ‘fair’ in adaptive qualities and capabilities, their ‘poor’ score in resource availability/vulnerability coupled with ‘very poor’ risk governance contributed to this. Compared to the endogenous rationale, many of their vulnerabilities and risks seemed exogenous and structural (especially those in public/administrative sectors) – far beyond these communities’ control. Adaptation, as a process of adjustment to actual or expected adversities (IPCC, 2014), remained fractional and delimited by external and internal issues.

Despite continuous upgrading, slums were still susceptible to microbial transmission during COVID-19. ‘Poor’ and ‘very poor’ (shared) WASH facilities in all but 03 slums and bad SWM (and FSM) in all slums contributed to this susceptibility. Chronic water-logging/flooding in 80% of slums due to broken drainage systems also worsened transmission risk, especially during rainy seasons. In addition, all slums scored ‘very poor’ in terms of housing/dwelling condition, resulting from insufficient lighting/ventilation and scant dwelling space that compromised possibilities for maintaining social distance and isolation/quarantine.

Almost all slum dwellers were informal jobholders except for those in 04 slums located on government-owned Jute Mill land. During the pandemic, out of the total 29, these 04 scored ‘good’ due to dwellers’ permanent employment in these Mills who significantly benefitted from provident funds. Dwellers from another 11 slums scored ‘fair’ for having BDT8000–12000 monthly income. The remaining 50% scored ‘very poor’ for not having formal/permanent employment, savings, social safety net support, and access to credit (Table 5). In addition, the overall level of food security was ‘poor’ since all dwellers’ income was well below the national average. Therefore, despite dwellers’ ‘fair’ level of social networking, access to information, and connectivity in all slums, their weak economic capital, existing comorbidities, and misconception/stigma/superstition scored ‘poor’ and contributed to an overall ‘poor’ score for the sector/driver.

Shared and often inadequate/damaged WASH and SWM infrastructure, cramped housing conditions (with scarce in-house space), and lack of isolation/quarantine infrastructure revealed a ‘poor’ level of adaptive capacity during COVID-19. Temporary/informal occupation and food insecurity found in 25 slums also aggravated this. Even dwellers having HBE (in 02 slums) demonstrated ‘weak’ adaptive capacity due to the closure of markets. But communities/individuals with tenure security and better social capital/connectivity with people outside the settlement scored ‘fair’ in social terms. In healthcare, all but 03 slums scored ‘poor’; the COVID-time continuity of community-level healthcare services helped them with this ‘fair’ score. Preexisting comorbidities, unwillingness to avail hospitals, unaffordability to buy health kits, and the closure of community healthcare and municipal SWM services during COVID-outbreak yielded this ‘poor’ score. However, among the three drivers of resilience, dwellers’ *adaptation* capacity demonstrated an overall ‘fair’ level, primarily due to the ‘fair’ scoring in healthcare knowledge and awareness, adopted practices, and overall positive attitude to learning even amidst the pandemic.

Most slums falling under ‘fair’ and ‘good’ categories were the more consolidated ones (30–40yr. old). They demonstrated less economic and social vulnerability since their dwellers were mostly permanent (migrants), had higher income (and more HBEs), and held permanent employment. These were primarily located close to CBDs and industries (like Boro Bazar, Jute/Shrimp factories, Ghats) - areas with diverse informal economic opportunities. Dwellers living there had better social capital within and outside the community (Ward Councilors and local NGOs). These slums were also more prominent in size and more populated and had higher negotiation capacity with politicians. This capacity also yielded tenure security and better (but shared) WASH and SWM infrastructure in most. Most city-level female slum leaders also came from these slums. Most of these slums were either former resettlement projects (*Bastuhara*) or located adjacent to public land/properties (Jute Mill, Railway Land, *Khas* Land, etc.).

The closest thing to physical planning in slums is Slum upgrading. Upgrading programs in Bangladesh (e.g., SIP, LPUPAP) prioritize capacity-building, entrepreneurship training, housing/infrastructure improvement, construction of new roads/footpaths, drainage and toilets, and installation of tube wells (Panday, 2020). As found in this paper, most of these socio-spatial interventions are relevant in formulating planning/upgrading measures for COVID-19. Yet, planning/upgrading policies as such are still absent, nor any long-term planning goals for the present and future pandemic risk governance, adaptation, or mitigation being set so far. With the present and imminent COVID-19 waves, the need for a pandemic-resilient planning/upgrading policy framework for slums, especially on their socio-spatial management, with clear goals and long- and short-term strategies considering both ‘structural’ and ‘local’ issues, hence seem ever so important. However, continued government (KCC, DC) and NGO support/mediation in tenure security and aid/subsidy should be vital. In tackling slum dwellers’ complex poverty-profiles and associated vulnerabilities, the non-spatial dimensions (social capital/network, awareness/superstition, alternative livelihoods/entrepreneurship/skill developments like urban agriculture, HBE, etc.) need to be addressed alongside the spatial (indoor space organization, lighting/ventilation, location/distancing of community services, flexible/multiple use/increase of community infrastructure, improved WASH, SWM, and FSM, etc.). Since most slum

interventions are short/medium-term, non-spatial, and need-based, more longer-term, proactive, and integrated spatial approaches need critical exploration. In addition, flexible planning approaches will be needed to counter pandemics/shocks considering slum-wise variation.

6. Conclusion

Pre-COVID economic, infrastructural, and health-related issues had undoubtedly contributed to slum dwellers' COVID-time vulnerabilities. While poor infrastructure and sanitation, informal employment, livelihood diversity, superstition, and comorbidities remained the key 'internal' vulnerabilities, lack of institutional preparedness and safety-net programs, discontinued municipal services and inaccessible/untrustworthy healthcare services and corruption/bias/non-coordination in beneficiary selection were identified as the critical external vulnerabilities. Information sharing, openness to pandemic knowledge, and dwellers' active participation in awareness/training programs were found as the most common adaptive measures. Aid programs, despite criticisms, saved dwellers from starvation and proved quite essential for coping. However, systematic monetary aid gave dwellers the most flexibility in spending, while a few with permanent/secure tenure and regular income showed better economic resilience. On top, NGOs proved to be the key stakeholder in almost all sectors except for COVID-time planning/physical upgrading. For improving adaptive capacity, the flexible/innovative use of community infrastructure could play a vital role in future events. Hence, pandemic-focused planning policies should note slum-wise variations and need to be goal-driven, preemptive, flexible, multi-scalar, and integrated.

Authors' contribution

All authors differently contributed to the content. Salma Akter (Surma) drafted the manuscript, conducted interviews and coordinated the overall project. Sheikh Serajul Hakim conceptualized the research, took care of the methodology, provided critical comments and edited the manuscript. Md. Saydur Rahman (Lushan) conducted the fieldworks and coordinated with studied slum communities. All authors approved the final version of the manuscript.

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Declaration of competing interest

The authors declare that they have no competing interests.

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