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Changing pattern of livelihood capitals of urban slum dwellers during COVID-19 pandemic

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ABSTRACT

BACKGROUND AND OBJECTIVES: Historical reports show that COVID-19 pandemic has been confirmed over 213 nations or territories which accelerates the livelihoods. It also hampers the livelihoods of urban people's mainly poor slum dwellers in developing countries like Bangladesh. The purpose of this article is to assess the vulnerability of urban slum dwellers based on five livelihood capitals during COVID-19.

METHODS: Rajshahi City Corporation area is purposively selected which is grouped into three zones (central, interim and peripheral) based on the distance from the central business district, Shaheb Bazar. The study is conducted with a semi-structured and self-developed questionnaire to fulfill its objective. The questionnaires are focused on predetermined 48 indicators of five livelihood capitals (human, social, physical, natural and financial). Total 361 slum households (9%) are selected from 4010 households at 95% significance level which are proportionately distributed in 12 slum areas and household heads are nominated through simple random samplings. Data are coded, edited and inserted carefully; standardized and livelihood capital index are calculated with SPSS and map is produced with ArcGIS 10.4.

FINDINGS: Study reveals that about 47.8% (central), 57.5% (interim) and 45.1% (peripheral) slum dwellers are illiterate and live in a miserable condition. Human capital index is found higher in central slums (0.435) than peripheral (0.406) and interim (0.387). The social capital index is revealed as similar of human capital index. But physical capital index claims the trend as central (0.776)> interim (0.646)> peripheral (0.536). Again, financial capital index of the central slum dwellers is higher as they receive help during pandemic and get earning opportunity and these slum areas are located near the central business district. In addition, natural capital index is totally different and peripheral slum dwellers are in better position (0.635) than interim (0.549) and central (0.358) slums. Finally, the study concludes that mean livelihood capital index of central (0.4334) slum dwellers are better than interim (0.4216) and peripheral (0.4222) slums which assesses all the study slums as moderate.

CONCLUSION: The study suggests that financial improvement is becoming an ultimate need for slum dwellers since the financial capital index reveals as poor among all the slum areas. Moreover, individual or community-based strategies, international collaborations, government and non-governmental organizations need to come forward to improve not only the financial capital but also other four capitals in all slum areas to build a sustainable livelihood as majority of them live below the standard livelihoods.

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INTRODUCTION

Globally, COVID-19 pandemic has dramatically changed the pattern of livelihood capitals in the urban slum dwellers. This unexpected pandemic has introduced a new shape of livelihoods which accelerates the living standard of human beings (Saini and Deepak, 2021; Alzghoul *et al.,* 2022). The livelihood capitals are essential for determining the status of one's living standard. Now-a-days livelihood study is becoming popular due to disastrous phenomena and sudden pandemics in the world but our country Bangladesh is not exception of this. Therefore, livelihoods are the resources, skills, and pursuits through which an individual use to obtain basic needs for survival (Ouko *et al*., 2020; Mutea *et al*., 2019). The collection or opportunity set of skills, resources and activities are needed to support a living that is often referred as livelihood (Olsson *et al.,* 2014; Ellis *et al.,* 2003; Chambers and Conway, 1992). On the contrary, households seek for a way of life that is both highly resilient and less sensitive to pressures and shocks (Béné, 2020). When people and households adjust to unforeseen situations, they frequently manage their assets and activities in an opportunistic or reactive manner rather than with predetermined '*strategy*' (Manlosa *et al.,* 2019; Rakodi, 1999). For this reason, Elasha *et al.* (2005) emphasized livelihood as the concept of '*livelihoods*' which refer to the ways, pursuits, rights and resources for individual's use to support themselves and it is frequently used to refer to the resources and abilities that people and families use to create plans for their survival and well-being (Lemessa *et al.* 2023; Ablo *et al.* 2020). In addition, household frequently holds a number of capitals or assets which is access to natural, human, physical, financial, social, and cultural capital (Singgalen *et al.* 2019). For earning basic standard of living the household tries to enhance their capitals or assets. The activities which enhance their income level and livelihood strategies is also sum-up with all the capitals or assets. The need for access to livelihoods is a burning issue by the chaotic scenario followed by COVID-19 pandemic (Yazdanpanah *et al.,* 2021; Jackson, 2020). Eventually, people rely on a variety of capitals and assets that usually reveals how they support their livelihoods in developing nations (Guillotreau *et al*., 2012). The social relationships of people rely on the combination, transformation and expanding their assets, the ways that people utilize and enhance their capabilities to act and the ways people make lives meaningful that influence how they are able to function it regularly (Olsson *et al.,* 2014; Bebbington, 1999; Scoones, 1998). According to DFID (1999), human capitals are skills, knowledge, ability to work and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. It also includes leadership's potential, ability to work in adverse condition, health status, skills, knowledge and experience about the pandemic condition. In different perspective, human capital can be strengthened by involving best and skillful candidates in order to develop any company's performance (Santos, 2023). In addition, companies require human capital with a desire and capacity to come up with original ideas, create innovative techniques and take advantage of new chances while they are creating new goods and streamlining management procedures (Amani *et al.* 2022; Scarbrough, 2003). Moreover, social capitals are network-connectedness, memberships of formalized group, even the relationships, belief, exchange thoughts to one another and it serves as a source of data and assets that would be challenging to obtain (Craig *et al.,* 2022). Physical capitals are those which includes the essential producer's commodities and infrastructure required to sustain livelihoods and it also requires particular supervision in order to improve financial condition (Usman and Wirawan, 2021). Financial capitals are those which people employ to accomplish their living goals. Generally, it indicates the utilized money to purchase consumer items required for the survival and manufacture as well as the accessibility of loans (Kuang *et al.,* 2019; Jezeer *et al.,* 2019; Zhifei *et al.,* 2018; Li *et al.,* 2017). It also takes into account both flows and stockpiles which can affect both consumption and output. On the other hand, natural resources and services that enhance human well-being are included in natural capitals (Kuang *et al.,* 2019; Pandey *et al.,* 2017b). Natural capitals are the resources that make up from indivisible assets employed directly for manufacturing to intangible public goods like the environment and biodiversity, such as, trees, land, irrigation systems, ponds, etc. (Sharna *et al.,* 2020). Therefore, these five livelihood capitals provide information on how effectively people can adjust to changing circumstances and utilize their resources to deal with

particular dangers (Bhowmik *et al.,* 2021; Koomson *et al.,* 2020). Additionally, strong livelihood capitals signify a more resilient state that lessens the vulnerability of people to threats (Bhowmik *et al.,* 2021; Apine *et al.,* 2019). The number of poor people is increased globally from 15.75-24.5 million between 2015-2012 for the dominating factors COVID-19 (Boughton *et al.,* 2023). Moreover, World Bank predicts that about 71-100 million people fall into extreme poverty (about USD 1.90 per day) primarily in sub-Saharan Africa and another 176-231 million people fall into poverty (about USD 3.20 per day) in South Asia (Alizadeh *et al.,* 2023; Johri *et al.,* 2021). There are several existing researches which examine the livelihood capitals status in different context. Paul (2013) assesses the post-cyclone livelihoods capitals status of coastal households. Rahman and Siddik (2018) analyze the status of the char dwellers livelihood and the relationship between the various capitals and level of well-being. Livelihood options of the informal sector employees were drastically worsening due to closure of urban centers during COVID-19 in Ghana (Amoah-Nuamah *et al.,* 2020). Lustig and Tommasi (2020) reveal the strategies to lower epidemiological risks to protect lives, safeguarding livelihoods and try to ensure human capital accumulation. LIU *et al.* (2021) suggests that the livelihood capitals of farmers are benefited greatly from industrial growth. Rahman *et al.* (2021) explores the livelihood status of shrimp producers which is negatively impacted by COVID-19. Overall farmers in the main epidemic areas do not have much capital for their livelihoods and after the epidemic restoration of livelihoods is largely dependent on the growth of their financial and human capital (Zhao *et al.,* 2021). Islam *et al.* (2021) examined the signs of depression and post-traumatic stress disorder and relevant factors of related to financial worries of the underprivileged urban residents during COVID-19 pandemic. Soma *et al.* (2022) focuses primarily on the situation of Dhaka in order to obtain a clear knowledge of the relationships between the livelihood capitals owned by slum households and their housing conditions. A study of China revealed that peasants' perception of risk which is substantially heightened by COVID-19 pressure and it lowers their livelihood capital (Zhao *et al.,* 2022). Okyere *et al.* (2023) performs a quantitative investigation in Ghana's Greater Accra Region's Adenta Municipality and discovers a negative correlation between COVID-19 impacts and five urban livelihood capitals. Manzoor *et al.* (2022) investigates several types of social capitals and how it assists during the COVID-19 in urban settlements in Dhaka, Bangladesh. Jowarder (2023) reveals that COVID-19 has made rickshaw pullers more depressed, anxious and at risk of losing livelihoods. A review paper by Habib *et al.* (2023) claims the impact of five livelihood capitals on diversification livelihood strategies in developing countries. Fahad *et al.* (2023) examines the several facets of impoverished households' poverty situation in *Ha Giang* province, Vietnam by using DFID's framework and tries to find the most deficient capitals. As mentioned earlier, there are several researchers who tried to reveal the capitals status, impact and importance on individual or community livelihoods and the measurement criteria are varied in different situations. However, very few studies put emphasize control over five livelihood assets/capitals (i.e. human, social, physical, financial and natural capital) of urban slum dwellers incorporating with COVID-19 pandemic. The urban slum dwellers livelihood capitals are mostly neglected in this regard. Again, it is not clear about the changing pattern livelihoods capital of urban slum dwellers during pandemic since all kind of economic and income generating activities are almost stagnant. COVID-19 has changed the livings of global population and the conditions of the urban slum dwellers are not deeply considered. In the context of Bangladesh, there are few researches on poor dwellers livelihood of Dhaka City Corporation but cities outside Dhaka is almost absent. To minimize this research gap, the objective of the study is to assess the changing pattern of livelihood capitals and vulnerability of the slum dwellers of Rajshahi City Corporation area in Bangladesh during COVID-19 between June-September 2022.

Sustainable livelihood framework

The idea of sustainable livelihoods has dominated the development initiatives in underdeveloped economies, notably in Africa, Latin America and central Asia (Jackson, 2021; Cline-Cole, 2016). The framework that is most frequently accepted by academicians is the Sustainable Livelihood Analysis (SLA) framework which was developed by United Kingdom (UK) Department for International Development (DFID)

in 2003 (Su *et al.,* 2021; Su and Yin, 2020). DFID conceptualizes the framework as a household's sources of income based on the accessibility of capitals for subsistence in a certain political and institutional settings (Trang and Loc, 2021; Simon and Khambule, 2021). This SLA framework (Fig. 1) considers five different types of livelihood capitals (human, social, physical, financial and natural) and these livelihood capitals are regarded as the key component of the framework (Su *et al.,* 2021). In this context, capitals are described as both natural/biological (i.e., land, water, common-property resources, flora and fauna) and social (i.e., community, family, social networks, participation and empowerment) as well as human (i.e., knowledge and skill generation) and physical resources (i.e., roads, markets, clinics, schools, bridges). The framework for sustainable livelihoods aids in organizing the variables that limit or improve livelihood prospects and demonstrates their interrelationships. It also seeks to broaden the fundamental idea that many families have access to different resources for sustaining their way of lives (Serrat, 2017). However, the DFID's sustainable livelihood framework is a people-centered approach which is mainly prioritized to this framework (Nasrnia and Ashktorab, 2021; Pandey *et al.,* 2017a; Quandt *et al.,* 2017). In household livelihood research, this framework is now extensively utilized and widely recognized paradigm around the globe (Kuang *et al.,* 2019; Pour *et al.,* 2018; Zhifei *et al.,* 2018) and it is used in this research also (Fig. 1).

MATERIALS AND METHODS

Study area and sampling

The present study uses mix-method approach that means both qualitative and quantitative data are gathered to achieve the objective of the study. In order to fulfill the study objective, the Rajshahi City Corporation (RCC) slum areas (twelve slum) are purposively identified. Slums of RCC are also categorized into three slum areas, such as, central, interim and peripheral (Fig. 3) from Central Business District (CBD) of Shaheb Bazar. Central slum area is enclosed within 1.5 km, followed by interim slum area by 1.5-3.5 km and peripheral slum area by >3.5 km respectively from the CBD. Household holding information are collected from the slum leaders of twelve slums and sample size 361 (out of 4010 households) are determined by using Kothari's formula (Kothari, 2005) for known population at 95% confidence level. The number of samples is determined by simple random samplings procedure which are proportionately distributed into three defined slum areas. Primary data are accumulated

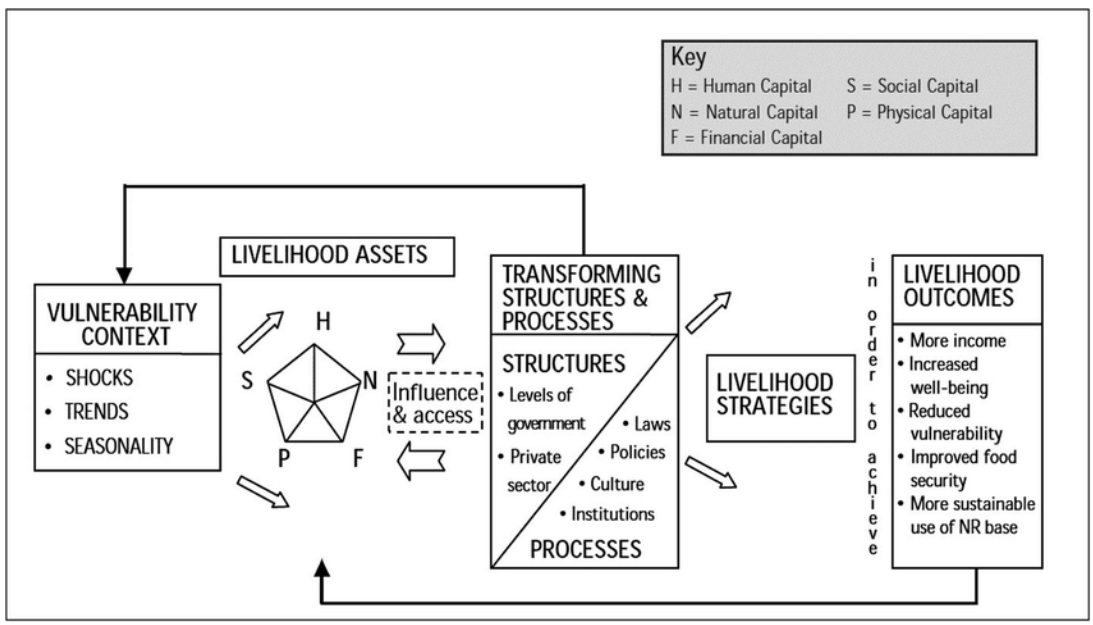

Fig. 1: Schematic diagram of SLA framework (DFID, 1999)

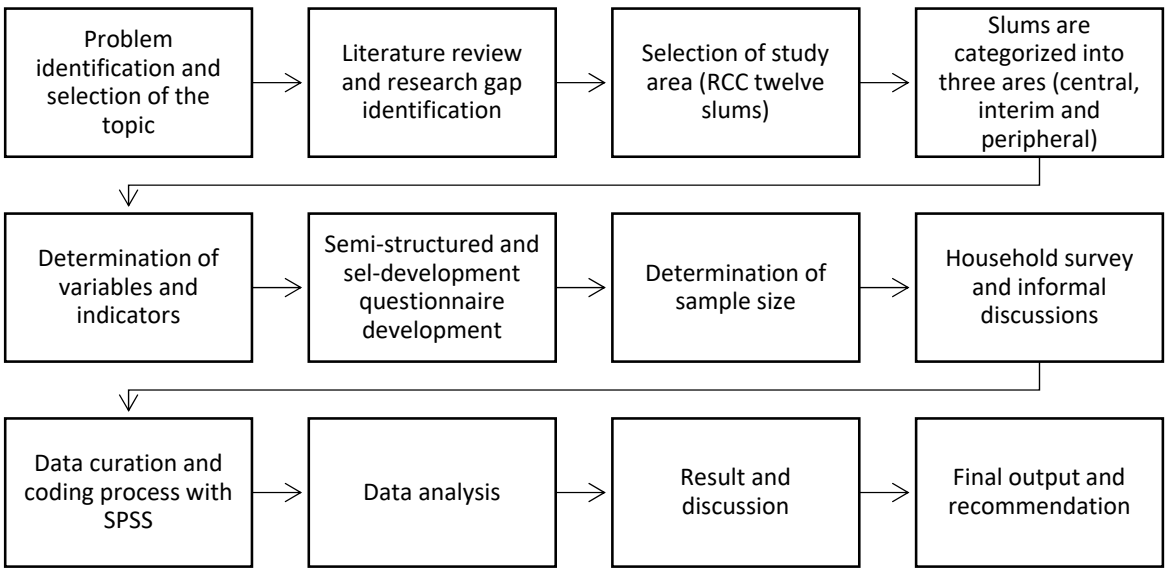

Fig. 2: Schematic diagram of the conceptual framework of the study

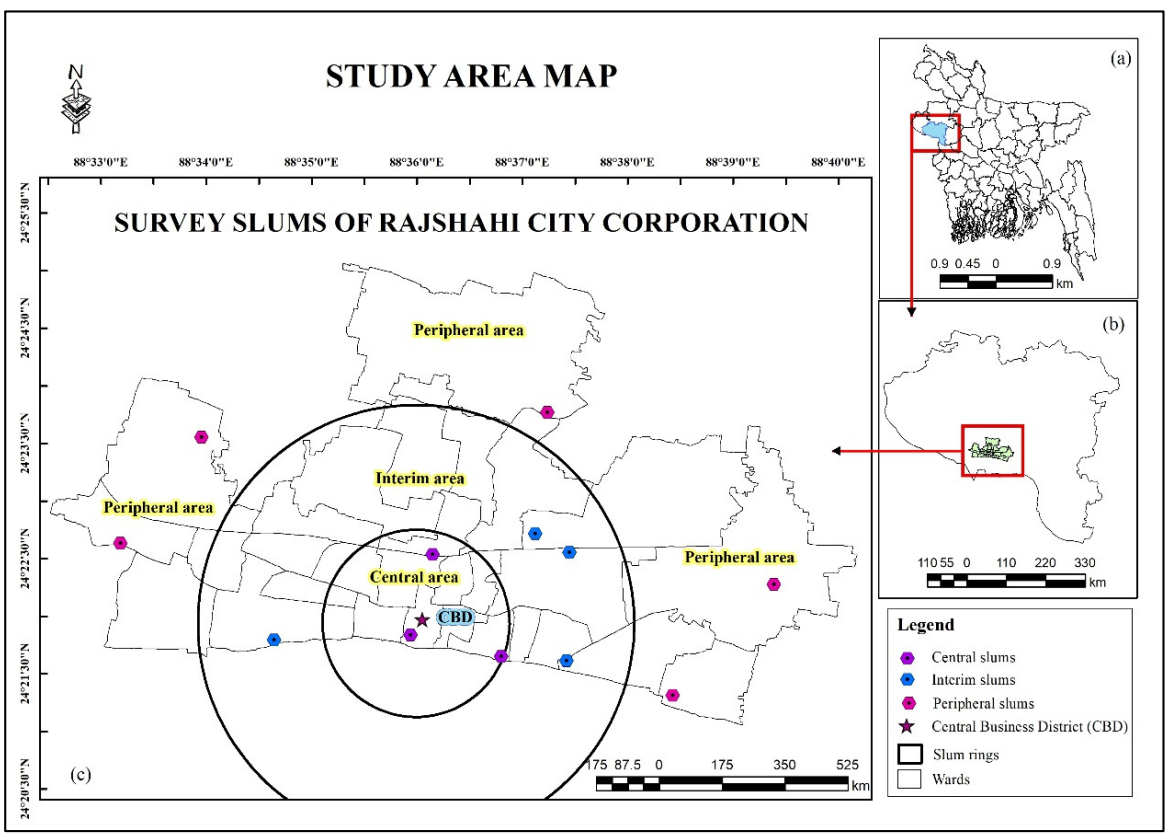

Fig. 3: Geographic location of the study area; (a) Bangladesh, (b) Rajshahi District, (c) Study slum area (Banglapedia, 2021)

through a semi-structured and self-developed questionnaires survey with pre-tested five-point Likert scale. The current study conducts with predetermined variables (i.e., human, social, physical, financial and natural capital) with 48 relevant indicators (Table 1) to reveal the livelihood capital status of slum dwellers in three separate areas. For gathering additional information and validation of survey data, informal discussions are also conducted in the three slum areas. The SPSS (version 25.0) software is used for coding and analysis of the accumulated data of the household survey (Fahimah *et al.,* 2023) and Arc GIS (version 10.4) is used for mapping (Khan *et al.*, 2023). Analysis of Variation (ANOVA), chi square and t-test are performed to identify statistically significant difference among the slum areas (Samimi and Nouri, 2023; Samimi, 2024). The conceptual process is presented in Fig. 2 for better understanding the research methodology.

Measuring livelihood capitals

According to DFID and CARE internationals livelihood framework, an analytical model is developed by identifying the relevant indicators of five livelihood capitals and those indicators are defined considering the slum dwellers livelihoods of Bangladesh. However, a five-point Likert scale is used to measure five types of livelihood capitals considering the discrete values of 0.20, 0.40, 0.60, 0.80 and 1.0. In addition, this scale is used to calculate the five livelihood capitals value of the study respondents (Paul, 2013) and assessment scale is classified into poor (<0.33), moderate (0.34-0.67) and high (>0.67) to reveal the status of livelihood capitals (Khan and Paul, 2023). Each of the livelihood capitals indicators (Table 1) are calculated separately for three individual slum zones to get separate capital index.

Human capital

Average year of schooling or enrolment rate has been the most often utilized proxy up to measure human capital (De Silva and Yamao, 2007). In addition to have inherent worth, human capital—knowledge and labor or the ability to command labor is necessary for utilizing any of the other four categories of assets (DFID, 1999). The knowledge, talent, creativity and health of the individual have actually been described as human capital (Pasban and Nojedeh, 2016). To assess the essential elements of human capital across economies a worldwide tool was introduced in 2018 as Human Capital Index (HCI), which is the component of human capital (World Bank, 2021). Though, using indicators such as, school enrolment, average years of education or adult literacy rate are known as indicator approach to identify a nation's investments in human capital (Abraham and Mallat, 2022). Overall human capital index is calculated by Eq. 1 (Rahman *et al.,* 2020; Paul, 2013) with considering 11 indicators. Before calculating the overall human capital index, individually each indicator of human capital (Table 1) is calculated separately and finally total aggregated value is divided by total indicators.

Social capital

In general, social capital is composed of relationships among groups, affiliations, networks, and interactions (Adger *et al.,* 2003). Through a certain form of communication with one another, people and communities may access certain resources and capitals (Nasrnia and Ashktorab, 2021). When it comes to the dynamics and growth of social aspects among urban dwellers, then social capital is regarded as one of the sources of human interactions which plays a significant role (Allahyari and Khakzand, 2019). According to Nooripoor and Noori (2012) social capital in any group reflects the degree of interpersonal trust and societal cohesion. Though, it can help a person to increase the financial income and savings rate. It also can improve people's knowledge and capabilities through enhancing social bonding and relationships. Generally, it is interconnected with other assets, including human, physical, financial and natural capital and may have an impact on a variety of aspects of a person's life as well as on society at large (Craig *et al.,* 2022; Volker, 2020). Though, it is controversial to other kinds of capitals and is highly developed in informal settlement (Braun and Aßheuer, 2011). Even though the definition of the social capital is haggled (Castiglione *et al.*, 2008) but it may be defined as social resources that allow a person to claim access to resources that they would not be able to pay or acquire (Braun and Aßheuer, 2011). However, in the present study indicators of social capitals are in four individual broad groups (Table 1). These four groups of social capitals (MCICI, PACI, MI and SCBI) are determined by Eq. 2 to 5 and finally the mean of these indicators is declared as overall social capital index is determined by Eq. 6

Table 1: Livelihood capitals with indicators

Livelihood capitals	Indicators	
Human capital	Level of education[1,3,5,6,7,8]	
	Mental stress due to COVID-19[1,8]	
	Work in adverse COVID-19 situation[8]	
	Experience in health related training program[1,2,3,5,6,8]	
	Gain new knowledge on COVID-19[8]	
	Solving problems during COVID-19[2,8]	
	Voted as a representative of any group or groups community[8]	
	Solve their problem within the group[8]	
	Participate in community activities during COVID-19[2,8]	
	Facilitated community and GO-NGO activities in COVID-19 situation[8]	
	Solve any conflict in the slum community during the COVID-19[8]	
Social capital	Mass Communication and Individual Communication Index (MCICI)	Mobile phones[2,8]
		Television[8]
		Newspaper[8]
		Printed materials/leaflet[8]
		Health and family planning worker[2,8]
		City corporation[8]
		NGO's[1,2,3,5,6,7,8]
		Police and law enforcement[8]
	Participation and Connection Index (PACI)	Participation in community based awareness programs of COVID-19[8]
		Participation on disaster (COVID-19) mitigation activities[8]
		Connection with NGOs for COVID-19 mitigation[8]
		Household head relationships with others in the community[1,4,7,8]
		Assisting each-other during COVID-19 pandemic crisis[4,8]
	Membership Index (MI)	Voluntary group[2,8]
		Religious group[2,8]
		Co-operative group[1,2,3,5,6,7,8]
		Micro-credit group[2,8]
		Closely associated with City corporation[2,8]
	Social Connection and Bonding Index (SCBI)	Social connectedness[8]
		Assist in slum[8]
		Accessibility in slum[8]
		Borrowing[8]
		Getting help[8]
Physical capital	Access to road to reach market[8]	
	Access to electricity system[8]	
	Access to transport services[8]	
	Access to latrine[8]	
	Access to sanitation system[8]	
	Access to sewers system[8]	
Financial capital	Reserved cash[1,3,5,6,7,8]	
	Deposits in banks/cooperatives/groups[2,8]	
	Remittances[1,3,5,6,7,8]	
	Pensions[8]	
	Liquid assets (e.g. livestock, poultry, jewellery, furniture, storage of food and cash crops, trees) which can provide liquid money[2,8]	
Natural capital	Access to road to open water bodies[1,2,4,7,8]	
	Access to collect fuel wood[1,2,7,8]	
	Access to open grazing lands[2,8]	
	Access to government-owned lands[8]	

(Rahman *et al.*, 2020; Paul, 2013). However, higher social index represents low vulnerability to COVID-19 pandemic in the study area.

$$HCI = \left(\frac{\left(\sum HCI1/N + \sum HCI2/N \ldots\ldots \sum HCI11/N\right)}{11}\right) \quad (1)$$

$$MCICI = \frac{\left(\sum MCICI1/N + \sum MCICI2/N \ldots\ldots \sum MCICI8/N\right)}{8} \quad (2)$$

$$PACI = \frac{\left(\sum PACI1/N + \sum PACI2/N \ldots\ldots \sum PACI5/N\right)}{5} \quad (3)$$

$$MI = \frac{(\sum MI1/N + \sum MI2/N \ldots\ldots \sum MI5/N)}{5} \quad (4)$$

$$SCBI = \frac{(\sum SCBI1/N + \sum SCBI2/N \ldots\ldots \sum SCBI5/N)}{5} \quad (5)$$

$$SCI = \frac{(\sum MICI + \sum PACI + \sum MI + \sum SCBI)}{4} \quad (6)$$

$$PCI = \frac{(\sum PCI1/N + \sum PCI2/N \ldots\ldots \sum PCI6/N)}{6} \quad (7)$$

$$FCI = \frac{Av}{Ava} \quad (8)$$

$$NCI = \frac{(\sum NCI1/N + \sum NCI2/N \ldots\ldots \sum NCI4/N)}{4} \quad (9)$$

Here,

HCI = Human Capital Index; HCI_1, HCI_2..... HCI_{11}= Human capital indicators; MCICI = Mass Communication and Individual Communication Index; $MCICI_1$, $MCICI_2$.... $MCICI_8$ = MCICI indicators; PACI = Participation and Connection Index; $PACI_1$, $PACI_2$.... $PACI_5$ = PACI Indicators; MI = Membership Index; MI_1, MI_2.... MI_5 = MI indicators; SCBI = Social Connection and Bonding Index; $SCBI_1$, $SCBI_2$.... $SCBI_5$ = SCBI indicators; SCI = Social Capital Index; PCI = Physical Capital Index; PCI_1, PCI_2..... PCI_6 = Physical capital indicators; FCI = Financial Capital Index; Av = Available financial deposit and monetary value of liquid assets of each slum household; Av_a = Average available financial deposit and monetary value among the slum areas; NCI = Natural Capital Index; N=Total sampled respondents.

Physical capital

A household's physical capital is made up of its foundational structures and other tangible assets (Braun and Aßheuer, 2011; Krantz, 2001). According to Braun and Aßheuer (2011), the most important types of physical capital in the case of Dhaka's slum residents are housing, shelter, sanitation and water supply. In terms of shelter, it is frequently known as privately owned and some of them are utilized for free-based consumption such as toll roads and energy supplies (DFID, 1999). However, in this study physical capital index (PCI) is measured with the help of Eq. 7 (Rahman *et al.,* 2020; Paul, 2013) considering six indicators tabulated in Table 1.

Financial capital

There are two main sources of financial capital which was determined by DFID in 1999 and these two sources are available stocks and regular inflows of money respectively. Likewise, a household's financial capital is made up of two main components: first, the regularly received returns or income and second, the savings of the household which is also revealed by Braun and Aßheuer in 2011. However, out of the five types of capitals, this capital is arguably the most adaptable one. The value of each household's liquid assets, such as cash reserves, deposits in banks, cooperatives and groups, remittances, pensions and liquid assets from livestock, poultry, jewellery, furniture, storage of food and cash crops, trees and other assets that can provide liquid money, are some important indicators use in the current study to measure the financial capital index (Paul, 2013). To calculate the financial capital index, all forms of such assets converted into monetary values for each slum household and then it was divided by the average available financial deposit and monetary value among the slum areas. The Eq. 8 is used to measure the financial capital index derived and modified from Rahman *et al.,* 2020; Paul, 2013. However, higher the financial index represents higher level of financial capital which indicates lower vulnerability to COVID-19 pandemic as the slum dwellers can secure their livelihoods.

Natural capital

DFID (1999) emphasizes that those who depend entirely or partially on resource-based activities place have a high value on natural capital such as, farming, fishing, gathering fuel wood from forests, mineral extraction, etc. Though, containing all the natural resources that individuals can use to improve their quality of life is called the natural capital (Braun and Aßheuer, 2011; Krantz, 2001). In this current study, Natural Capital Index (NCI) is calculated by adding the average of four selected natural capital indicators (Table 1) by Eq. 9 (Rahman *et al.,* 2020; Paul, 2013).

RESULT AND DISCUSSION

Socio-demographic profile of the slum dwellers

The study reveals that the age of the slum respondent ranges between 18-65 years. Though 31-

60 years' age group are dominant in central (71.1%), interim (76.6%) and peripheral (68.2%) areas, followed by age group 18-30 years (central-23.3%, interim-16.7% and peripheral-25.2%) and >60 years (central-5.6%, interim-6.7% and peripheral-6.6%). Education reveals that majority of interim (57.5%) slum dwellers are illiterate, followed by central (47.8%) and peripheral (45.1%) slums (Table 2). Though, 23.3, 13.3 and 18.5% of central, interim and peripheral slum dwellers are primary qualified and about 15.6 (central), 20.8 (interim) and 13.9% (peripheral) slum dwellers know to read and write. Secondary educated slum dwellers are also observed among the slum areas (central-7.7%, interim-5.9% and peripheral-19.9%) but higher educated dwellers are found less in all slum areas (Table 2). Family size of the slum household are categorized into three groups to reveal the actual demographic scenario. About 70

Table 2: Demographic profile of slum dwellers

Criterion	Central		Interim		Peripheral		Tests
Age (year)	f	%	f	%	f	%	
18-30	21	23.3	20	16.7	38	25.2	t=68.849, Significance value=0.000, df=360, α=0.05
31-60	64	71.1	92	76.6	103	68.2	
>60	5	5.6	8	6.7	10	6.6	
Education level							
Illiterate	43	47.8	69	57.5	68	45.1	χ^2: F=21.617, df=8, p=0.006
Only can read and write	14	15.6	25	20.8	21	13.9	
Primary	21	23.3	16	13.3	28	18.5	
Secondary	7	7.7	7	5.9	30	19.9	
Higher study	5	5.6	3	2.5	4	2.6	
Gender							
Male	47	52.2	72	60.0	65	43.0	χ^2: F=7.765, df=2, p=0.021
Female	43	47.8	48	40.0	86	57.0	
Family size (member)							
1-3	24	26.7	40	33.3	53	35.1	t=51.214, Significance value=0.000, df=360, α=0.05
4-6	63	70.0	70	58.3	93	61.6	
>6	3	3.3	10	8.4	5	3.3	
Housing type							
Pucca (concrete wall and roof)	8	8.9	1	0.8	2	1.3	Likelihood ratio: Value=86.747, df=8, p=0.000
Semi-*pucca* (brick wall and CI sheet roof)	51	56.7	19	15.8	61	40.4	
Kactha (mud wall and CI sheet roof)	0	0.0	1	0.8	3	2.0	
Corrugated Iron (CI) sheets (wall and roof)	31	34.4	84	70.0	85	56.3	
Hut (*Jhupri*)	0	0	15	12.6	0	0	
Household income (BDT)							
<5000	2	2.2	5	4.2	6	4.0	t=38.547, Significance value=0.000, df=360, α=0.05
5001-10000	24	26.7	37	30.8	44	29.1	
10001-15000	28	31.1	35	29.1	59	39.1	
15001-20000	19	21.1	20	16.7	27	17.9	
>20000	17	18.9	23	19.2	15	9.9	
Land ownership							
Lease land	6	6.7	4	3.3	48	31.8	χ^2: F=48.001, df=2, p=0.000
Possession land	84	93.3	116	96.7	103	68.2	

(central), 58.3 (interim) and 61.6% (peripheral) of the slum households have 4-6 members, followed by 1-3 members are also found in central (26.7%), interim (33.3%) and peripheral (35.1%) slums and >6 members are found less percent which indicate maximum families are nuclear in size (Table 2). It is found that majority (56.7%) central slum dwellers housing is semi-pucca. On the other hand, 70 and 56.3% of interim and peripheral slum dwellers housing are built with CI-sheets. Eventually, concrete housing type are found less among the slum areas (central-8.9%, interim-0.8% and peripheral-1.3%). Because of several wage-earning opportunity, the slum household income differs among the study areas. It reveals that 31.1 and 39.1% of central and peripheral slum household income ranges between 10001-15000 BDT. Whereas, 30.8% of interim slum household's monthly income ranges between 5001-10000 BDT. Among the slum areas, about 18.9, 19.2 and 9.9% of central, interim and peripheral household's monthly income reaches >20000 BDT (Table 2). In term of land ownership, the study has revealed that majority (central-93.3%, interim-96.7% and peripheral-68.2%) of the slum dwellers are living in possession land. Though, 6.7, 3.3 and 31.8% of central, interim and peripheral slum household had lease land to live. However, the study founds significant differences exist among the slum areas in terms of age, education level, gender, family size, housing type, household income and land ownership (Table 2).

Household livelihood capitals

DFID (1999) reports five types of core capitals or assets which builds up livelihood. Resources which people have access are called assets and they can be either private (such as household capital) or public goods (community capital). The slum dwellers livelihoods have inter-connected with all these core capitals which is being the main issue of the vulnerable livelihoods during COVID-19 pandemic.

Status of human capital

Human capital of central slum area is higher (0.435) than interim (0.387) and peripheral (0.406) slum area which reflects the interim dwellers skill, knowledge, leadership, ability to work in adverse COVID-19 condition, ability to solve problems in community, level of education and attainment on training, gaining knowledge about the pandemic, facilitated community activities and GO-NGO activities in COVID-19 situation are poor among the slum areas. It also reveals that, the lower the human capital means higher vulnerability to COVID-19 pandemic. Comparatively, the interim dwellers are in vulnerable condition in terms of human capital value of the three study areas. The study was consistency with Lustig and Tommasi (2020) as they revealed that the urban poor specifically those who reside in slums are in a precarious position in terms of livelihoods focusing on human capital. However, the study finds significant difference among the slum zones in terms of human capital (Table 3).

Status of social capital

Social capital indicates that central slum dwellers have higher social capital index (0.484) which reflects the slum dwellers higher social connection and bonding, mass communication, individual communication, participation and connection and social cohesion is higher in the central slums. Whereas, it reveals almost similar index in interim (0.459) and peripheral slums (0.465) which also declares as moderate (Table 3). The research again claims that social capital vulnerability is also low in central area less than the other two slum areas as the value of the central is found higher in this regard central area dwellers. This study is consistent with

Table 3: Slum dwellers livelihood capital index

Livelihood capitals	Slum areas			
	Central	Interim	Peripheral	ANOVA
Human	0.435	0.387	0.406	F=5.013*
Social	0.484	0.459	0.465	F=2.380
Physical	0.776	0.646	0.536	F=82.068*
Financial	0.114	0.067	0.069	F=5.586*
Natural	0.358	0.549	0.635	F=40.072*
Mean index	0.4334	0.4216	0.4222	

* $p < 0.05$

Manzoor *et al.* (2022) that reveals greater access to aid (e.g., food, face masks and soap) and financial support is available to respondents who have built social capital networks outside of the slums.

Status of physical capital

The study reveals that central slum dwellers have higher physical capitals (0.776) among the slum areas (Table 2) that reflects higher range of physical assets, such as, higher access to electricity, transport, latrine, sanitation system and better sewers system. For this reason, central slum dwellers physical capital is less vulnerable. On the contrary, the physical capital value of the peripheral dwellers is found poor (0.536) than interim slum dwellers (0.646). Therefore, the condition of the physical capital slum dwellers varies among the slum areas as the vulnerability also varies. Moreover, significant differences exist among the three slum areas in terms of physical capital. However, it is denoted that the higher value of the physical capital index indicates lower vulnerability to the pandemic as the access to sanitation and sewerage system is found very important to reduce the COVID-19 disease. The study is consistent with Jowarder (2023) which reveals the livelihood of rickshaw pullers have no longer access to physical capital due to the COVID-19 pandemic.

Status of financial capital

The study reveals poor condition of the financial capital of the slum dwellers. However, the central slum area respondents have revealed higher financial capital index (0.114) in respect of other two slum areas. The reason is the central slum dwellers have ample opportunity for earning and making money in pandemic as these slums are located in the CBD. Whereas, the interim and peripheral dwellers financial capital index are found 0.067 and 0.069 (Table 3) as they have less opportunity for financial assets. The main reason behind this is the fewer capabilities of income or savings opportunities of peripheral areas. The study is consistent with Islam *et al.* (2021) which revealed that the majority of responders (96.3%) claims that the effect of COVID-19 has reduced their household income and decreased their financial capital. However, the study found statistically significant variation in the financial capital index among the slum areas which indicates that high vulnerability of financial capital of the interim and peripheral rather than central slum dwellers.

Status of natural capital

Present study calculates that central slum respondents have less value of natural capital index (0.358) than interim (0.549) and peripheral (0.635) slum dwellers (Table 3). The reason of less index of central slum dwellers is less opportunity of open water source, grazing land, access to fuel wood and access to government-owned land rather than other two slum areas. Poor natural capital values of central slums indicate limited natural resources and low access to natural assets due to compacted place in the CBD. Slum dwellers of the peripheral area reveals high value of natural capital index (0.635) as because they have ample access to the natural resources. Moreover, these slums are located in the peripheral side of the city corporation and have better access to the natural assets. Again, interim slum dwellers have better capital index (0.549) rather than the central part that reveals the central area slum dwellers are more vulnerable in terms of natural capital rather than the interim and peripheral slum areas. The study is consistent with Soma *et al.* (2022) which shows that natural capital has a significant role in determining the total amount of livelihood assets. In a nutshell, poor natural capital households are more likely to receive overall low natural capital scores for their means of livelihood. However, the current study has found statistically significant difference among the slum areas in terms of slum dwellers natural capital (Table 3).

Asset pentagon of the slum dwellers

For better understanding of the status of five livelihood capital index, slum areas are visualized by livelihood asset pentagon of the slum dwellers (Fig. 4). The interrelationships among five livelihood capitals, which influence one's way of life, are represented by the asset pentagon (Soma *et al.*, 2022). The asset pentagon represents the zero value in the center and in terms of access to capitals it raised up to scale value 1.00 as the study have measured in five-point Likert scale. In addition, the shape of the asset pentagon reflects the access to five livelihood capitals of the central slum dwellers (Fig. 4a). It indicates that poor value of natural capital (0.358) in respect to other capital values of the central slums. The human, social and financial capital value of the central slum

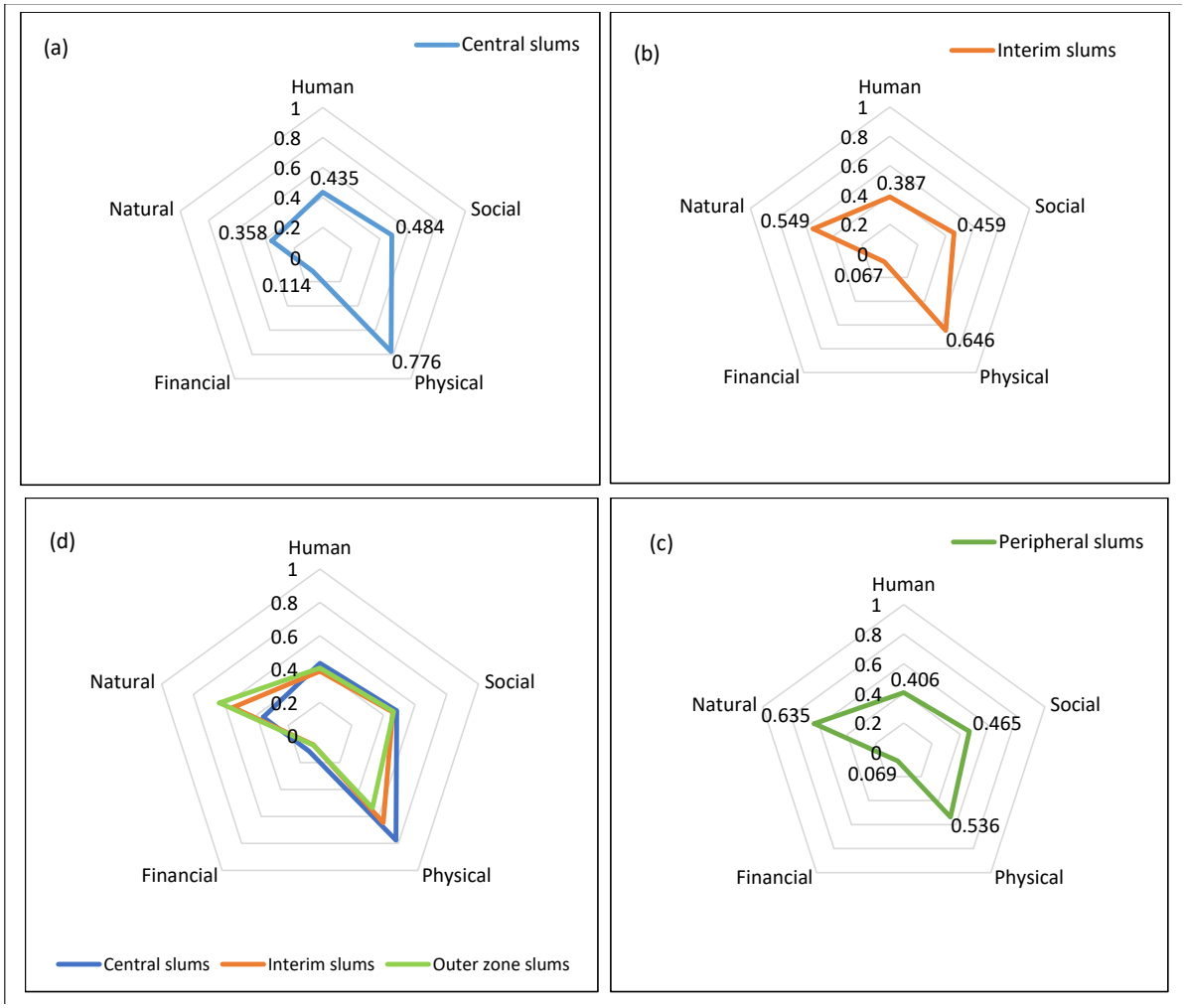

Fig. 4: Livelihood asset pentagon of (a) central; (b) interim; (c) peripheral; (d) comparative livelihood asset pentagon areas

dwellers are found poor to moderate in the range of the current study. Whereas, decent value of the physical capital (0.776) is found in this study which indicates less vulnerability to COVID-19 pandemic.

On the other hand, asset pentagon of the interim slum dwellers capital has been shown different status (Fig. 4b). The shape of the asset pentagon changes as the value of the livelihood capitals of the interim slum dwellers varies among slum areas. From the diagram, access to five essential livelihood capitals of the interim slum dwellers reveals that financial capital is found highly vulnerable (0.067). However, the social (0.459), physical (0.646) and natural (0.549) capitals index is higher than human (0.387) capital index of the interim slum area. Again, the peripheral slum areas reveal comparatively less access to five livelihood capitals of the peripheral dwellers from the CBD (Fig. 4c). In addition, the shape of the pentagon asset changes compared to central and interim slum dwellers livelihood capitals. Respondents of peripheral slum area have identified low financial capital (0.069) in respect of other four capitals (Human<Social<Physical<Natural). It also reveals that the natural capital is higher (0.635) than the other three capitals (e.g., human, social, physical capital). Moreover, the findings indicate that the peripheral areas slum dwellers are also in vulnerable situation due to the co-current pandemic situation. Finally, all three slum areas asset pentagon is combined to represent the data at a glance (Fig. 4d). It shows

quite similar index of human and social capital among the three-slum area. However, it is also expressed variation in financial, natural and physical capital among the slum areas which is consistent with Soma *et al.* (2022). These capital values are decreased from the central to peripheral slums. The higher the value of the capital in the border part of the asset pentagon is mentioning that lower vulnerable condition as they could access to the resources. Though, all the capital values of the slum dwellers livelihood capitals are denoted as poor during COVID-19 which is almost consistent with the study of Zhao *et al.* (2022). It is emphasized that the asset pentagon which consists of the main factors affecting livelihoods, is the most conspicuous component of SLF (Soma *et al.,* 2022; Mahama and Maharjan, 2019). In addition, Rahaman *et al.* (2022) reveals that during pandemic, human capital may be even more at risk than financial capital because it affects not only the knowledge, skills and labor potential of household members but also their health. The human capital index of the slum dwellers is found similar and assesses as poor. Therefore, the study finds the change in asset pentagon and which results in vulnerable situation due to COVID-19 pandemic in urban slum dwellers livelihoods of RCC.

CONCLUSION

Capitals are the main components of livelihood which compromise a balanced and strong human well-being. COVID-19 pandemic has changed the status of the livelihood capitals as it is in the recent past. Livelihood capitals of a household are more effective to combat such a pandemic issue as the world face a mammoth crisis in the last three years. The core objective of this paper has revealed the vulnerable livelihood capitals of the urban slum dwellers in respect to COVID-19 pandemic. The household which have the five capitals in a healthy value are considering as the less vulnerable household and more secure livelihood. The study examines that the central slum is relatively in better position than interim and peripheral slums that assess as moderate. However, central slum dwellers financial capital is still higher than the other two slum areas (central>peripheral>interim) due to variation on income and savings opportunity and it indicates that the central slum dwellers are getting ample opportunity for income generating activities and savings for future in crisis. Eventually, financial capital is found poor in interim or peripheral part because they are living far away from the CBD which indicates low status of livelihood. Majority of the respondents are unemployed and income opportunity has lowered the financial capital during COVID-19. The natural capital is found higher in peripheral slums than interim and central. Due to less access to the natural resources in the CBD, the natural capital is vulnerable from peripheral to central. It concludes that social capital reveals as similar in central, peripheral and interim which means the better social cohesion in the respective slum areas. The study reports high physical capital of central slum area than interim or peripheral area that indicates vulnerable slum areas are located far from CBD. Though, it also found that the human capital of central and peripheral slum areas is quite similar and declares as moderate vulnerable. By raising up regular screening and monitoring activities, vulnerable livelihood of slum dwellers can be converted into sustainable livelihood. The present study will play a significant role for the policy makers formulating sustainable livelihood plan for the slum dwellers which is regarded as practical implication of the current study. This research will contribute to the scientific world to rethink about the poor urban slum dwellers since the pandemic has changed their means of living and in most of the cases slum dwellers lived in a miserable condition as they hardly manage their essential livelihood needs. The major limitation of the present research is that it is conducted only on the urban slum dwellers which can be filled by incorporating by investigation on the other parts of the country. More specifically, the novelty of the topic introduces further research arena which can be implemented on the other urban and rural areas to unveil actual livelihood status of the poor dwellers after the pandemic.

Suggestion

Current study recommends that the government will give more attention to improve the financial capital of the slum dwellers by improving the wage-earning or income-generating activities in future pandemic situation as they are mostly unemployed. In addition, introducing community or individual-level strategies (e.g., enhance social bonding, working in groups, problem solving mentality), technological solutions (e.g., technological advancement, training and skill development for earing wages in pandemic

situation) or international collaboration opportunities will be helpful for the slum dwellers to change their miserable livelihood capital status. However, after considering the context of the present study it is urged that general awareness programs, health training programs, evenly distributed relief programs, food and nutritional security program regarding COVID-19 pandemic need to be improved to change the status of the livelihood capitals of the slum dwellers.

AUTHOR CONTRIBUTION

S. Tawsif and S.K. Paul contributed equally for developing methodology and conceptualize the study. S. Tawsif has conducted literature review, data processing and coding, analyzing and writing the original draft. M.S. Khan was responsible for evaluation, editing and rewriting the manuscript. Author S.K. Paul and M.S. Khan has critically revised the manuscript. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST

The authors state that they have no possible conflict of interest regarding the publication of this work. Additionally, the authors have also fully observed all ethical difficulties, such as, informed consent, data fabrication or falsification, misconduct, plagiarism, duplicate publishing or submission and redundancy.

ABBREVIATIONS

α	Significance Level
x^2	Chi Square
p	Significance Level
%	Percentage
df	Degrees of Freedom
f	Frequency
ANOVA	Analysis of Variance
BDT	Bangladesh Taka (Currency for Bangladesh)
CARE	Cooperative for Assistance and Relief Everywhere
CBD	Central Business District
CI	Corrugated Iron
DFID	Department for International Development
Eq.	Equation
FCI	Financial Capital Index
Fig.	Figure
GO	Governmental Organization
HCI	Human Capital Index
MCICI	Mass Communication and Individual Communication Index
MI	Membership Index
N	Total sampled respondents
NCI	Natural Capital Index
NGO	Non-Governmental Organization
PACI	Participation and Connection Index

PCI	Physical Capital Index
RCC	Rajshahi City Corporation
SCI	Social Capital Index
SCBI	Social Connection and Bonding Index
SLA	Sustainable Livelihood Analysis
SLF	Sustainable Livelihood Framework
SPSS	Statistical Package for Social Sciences

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