



The Study of Slum Definitions, its Demographic Characteristic and Distribution Patterns in Kathmandu Valley, Nepal

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Abstract: To achieve a better and more sustainable future for all, it is necessary to accomplish sustainable development goals (SDGs) by 2030. Among these goals, some of them are associated with slums and upgrading their status. Evidence-based development policies and programs are recommended for achieving developmental goals and for this purpose data along with their distribution pattern are the key components. The objective of this study is to present different slum definitions used in Nepal, make an update on the existing data about the slums inside the Kathmandu Valley, and explore their distribution. To accomplish this, published documents, as well as secondary data about slums, were collected and they were further verified and updated. Different names were found to be commonly used as a synonym for the slum. The total number of slum settlements inside the valley was found to be 65 with a total number of households of 4,696 a total population of 28,412 having a total male population of 14,829 (52.20%), and a total female population of 13,583 (47.80%). The distribution of slums across different wards inside the Valley was explored and was found to be overdispersed Poisson distribution revealing that slum settlements are widely dispersed among different local-level administrative units (wards) inside the valley, and further, a large variation in the number of households, population size, and average household size was found among those slum settlements. Due to these, it is challenging for the government to address the biggest deprivations of the slum communities' people to improve their living conditions and maintain an appropriate state of harmony in the Valley.

Key Words: Informal settlements, Population, Poisson distribution, SDG-2030, Slum, Squatters

1. Introduction

1.1 Origin, meaning, and definition of slum

The word slum first appeared in London during the 1820s to identify the poorest quality housing and the most unsanitary conditions; a refuge for marginal activities including crime, and drug abuse [35]. During the 18th and 19th centuries, the meaning, and uses of the word slum changed widely. Throughout the globe, different languages are used as a means of communication, and in those different languages, different words are used synonymously and interchangeably for the word slum and some of them are shanty, squatter settlement, informal housing, and low-income communities [35]. Complexities in the meaning arise when a variety of equivalent words are used interchangeably in different geographical regions and different countries [35].

Even the definition of slum differs by country [39], state [14], and city [15]. Different studies indicated that the meaning, nature, and characteristics of slum may be more heterogeneous than it is supposed to be [2], [8], [13], [24]. Besides these definitions of the slum, different generic definitions are discussed, but those definitions are not operational, so they cannot enable the researcher to ascertain whether a particular area is a slum or not. Due to the lack of an agreed definition, there will be confusion which will ultimately create a problem with measuring slums. Different types of the operational definition of slum and their pros and cons are discussed in the report [35].

Broader discussions on the globally accepted definition of slums are found in the study [29]. Until now, the government of Nepal has not provided any specific operational definition of a slum. Lumanti Support Group for Shelter, a Nepali non-governmental organization has defined squatter and slum as: "Squatter settlements are those communities where people have settled on land without any legal right to be there neither as tenants nor owners. These people may live on the land for decades; however, they have no legal title to the land. The stereotypical view of squatter settlements is a collection of temporary and poor structures [22]." Slum communities are defined in terms of poverty, low income, inadequate living conditions, and substandard facilities. These communities are usually inhabited by socially disadvantaged people but, unlike squatter settlements, the residents of these slums generally own their land and house which is very small in size, and have the formal title papers (*lalpurja*) to prove this. These communities are also officially recognized by the authorities [22].

The characteristics of Nepalese slums are as, "having inadequate basic infrastructure, inadequate services, permanent but old and dilapidated housing, small housing units, poor sanitary conditions, along with high-level legal land ownership status where the people from Dalit Newar community reside belonging to the low-level occupational status group like sweepers, butchers, etc. [22]." The characteristics of squatters are mentioned as inadequate basic infrastructure, inadequate or non-existence services, permanent and non-permanent housing, mainly made up of bricks with corrugated sheet roofs supported by bamboos and covered by plastic, small housing units, poor sanitary conditions, and no legal land ownership. However, some communities have permission from wards (local level governmental administrative units) to remain and live where they are at the moment. They are composed of mixed cast residents, predominantly belonging to hill ethnics groups, and a mixture of different occupations, mainly laborers [22]. Further, there is another type of settlement that exists in the Kathmandu Valley, known as *Hukumbasi* and *Swabasi* [22], [30]. The term *Hukumbasi* is defined as, "A *hukumbasi* is someone who pretends to be a *sukumbasi* to obtain a land title, *lalpurja*, as well as other advantages granted to the underprivileged [40]." The term *Swabasi* is defined as, "The *Swabasi* are poor people, mainly belonging to *Dalit* and having lived in the Kathmandu Valley for a very long time. They are assimilated more or less to *autochthonous people* that are *aadivasi*, commonly known as Indigenous settlements [22], [30]."

In Nepal, commonly, the word *sukumbasi* is used to represent those people living in the slum. In legal language, a *sukumbasi* is a person who can prove that nobody in his family over the last three generations held any land title, *lalpurja* (an official document provided by the Nepal government declaring that the document holder has land inside the country in his name). The place where *sukumbasi* lives are known as *sukumbasi basti*. So, *sukumbasi*, and slum dwellers both have almost similar characteristics and meanings. Even squatter, slum settlements, and *sukumbasi basti* all have similar definitional meanings but the legal status of owning the land is different among those groups. Characteristics of Nepali squatters, slum, *hukumbasi*, and *swabasi*, are almost similar [22].

To overcome the ambiguities and confusion regarding the definition of a slum, the United Nations has developed the operational definition of a slum, which is defined as one or a group of individuals living under the same roof in an urban area, lacking in one or more of the following five amenities: Durable housing; Sufficient living area; Access to improved water; Access to improved sanitation facilities; and Secure tenure [24].

In this study, all types of settlements: slum, squatter, *hukumbasi*, and *swabasi* are considered slum because all of them have slum-like or even worse characteristic [35], and even if any one of them have not been formally designated as slum they can be studied under the domain of slum [9].

1.2 Kathmandu Valley

The Kathmandu Valley is situated in the middle hilly belt within the geographical coordinates 27°32'13" to 27°49'10" North latitudes and 85°11'31" to 85°31'38" East longitudes, and consists of three districts, namely, Kathmandu, Bhaktapur, and Lalitpur [31]. The Valley has an area of 721.87Sq. Km. covering Kathmandu and Bhaktapur and approximately 50% land area of Lalitpur district, Nepal [17], [19], [29]. According to the national population and housing census 2011, the total population living in these three districts is 2,517,023, and among these three districts, Kathmandu district has the largest population along with the highest population growth rate of 4.78%, and this population size and growth rate is the largest among all the 77 districts of Nepal [6].

Kathmandu district consists of one metropolitan city, Kathmandu metropolitan city, along with other ten municipalities- Budanilkantha Municipality, Chandragiri Municipality, Gokarneshwar Municipality, Kageshwari Manohara Municipality, Kirtipur Municipality, Nagargun Municipality, Dakshinkali Municipality, Shankharapur Municipality, Tarakeshwar Municipality, and Tokha Municipality. The total population of the Kathmandu district is 1,744,240 [6].

Lalitpur district consists of one metropolitan city, Lalitpur Metropolitan City along with the other two municipalities- Godawari Municipality, Mahalaxmi Municipality, and other three rural municipalities – Konjyoson Rural Municipality, Bagmati Rural Municipality, and Mahankal Rural Municipality. The total population of Lalitpur district is 468,132 with an annual population growth rate of 3.26% [6].

Bhaktapur district consists of four municipalities- Bhaktapur Municipality, Changunarayan Municipality, Madhyapur Thimi Municipality, and Suryabinayak Municipality. The total population of Bhaktapur district is 304,651 with an annual population growth rate of 3.01% [5], [6].



Figure 1. Map of Kathmandu Valley [27]

1.3 Population and slums: Global and National scenario

The world's population is expected to reach 7.7 billion in the middle of 2019 and is expected to increase by 2 billion persons in the next 30 years. This increases continuously with a great variation in population growth rate across the regions [11]. In 2018, an estimated percentage of the world's population living in urban

settlements was 53.3 [10]. Soon, there will be a rapid expansion of the urban population, particularly in Asia and Africa [37].

Globally the estimated number of people living in inadequate housing is 1.6 billion out of which one billion people live in slums and informal settlements [31]. The majority (332 million) of those slum dwellers are living in Eastern and South-Eastern Asia followed by Central and Southern Asia (197 million), and Sub-Saharan Africa (189 million) [32].

The world's five biggest slums are Khayelitsha, Cape Town, South Africa; Kibera, Nairobi, Kenya; Dharavi, Mumbai, India; Ciudad Neza, Mexico City Mexico; and Orangi Town, Karachi, Pakistan having a population size of 0.4 million, 0.7 million, 1 million, 1.2 million, and 2.4 million, respectively [16].

Based on the national population and housing census 2011, the total population of Nepal was recorded as 26.5 million with an annual average population growth rate of 1.35 percent, and a sex ratio of 91.6. The mid-year total population of Nepal for 2019 was estimated to be 28.61 million. In Nepal, 17.1 percent of the total population are living in urban areas [5].

Although urban areas' slum dwellers and squatters are an emerging issue, the Nepal government, as well as NGOs working in Nepal, don't have sufficient and up-to-date information about them [26]. Until 2014, the number of people living in slums was half a million [25]. A portion of these people is living in the slums inside the Kathmandu Valley. According to a past study, 75 such settlements were identified in various locations inside the Kathmandu Valley [30]. Although the exact size of the population living in slums in Kathmandu Valley is still not clear, roughly more than 31 thousand people are living in these urban slums. The size of the population living in slums in Kathmandu Valley is increasing and if the current trend remains constant, the population living in these areas is estimated to be 38, 262 in 2024 [31].

1.4 The rationale of the study

A large number of governmental bodies, non-governmental organizations as well as academic institutions are regularly conducting multidisciplinary academic as well as action-oriented policy research focusing on the population living in the slums of Kathmandu Valley. Complete and updated information about the population and household distribution in the slums, along with the distribution of slums inside the Valley itself will be a very useful resource for government, researchers, and policymakers. Besides these, to achieve Sustainable Development Goals (SDGs) by 2030, a country should be able to achieve the agenda 11.1 of SDGs stated, "ensure access for all to adequate, safe and affordable housing and basic service and upgrade slums by 2030". This is one of the indicators of SDG, and the UN Statistics division classified this as a tier I indicator. To achieve this indicator, a country must have sound information and a database on a proportion of the urban population living in slums, informal settlements, or inadequate housing. Besides agenda 11.1, the other goals (SDG 1, SDG 5, SDG 7, SDG 10, SDG 11, SDG 16, and SDG 17), and 9 targets of the 2030 Sustainable Development Agenda are linked to participatory slum upgrading and prevention [33], [34], [38].

Since there is a lack of updated information about the distribution of the population living in the slums and their demographic characteristic, the distribution of households in the slums, and the distribution of slums in the Valley, the primary objective of this study is to make the information about their distributions updated and at the same time to explore an appropriate probability distribution of slums among different wards inside the Valley. The objective of this study is also to present different ways of explaining the slums and to present different names that are frequently and interchangeably used in Nepal as synonymous for slums.

2. Methodology

Both primary, as well as secondary data, were used in this study. The secondary data were those collected by two different Nepali NGOs, viz. Nepal Mahila Ekata Samaj, a network organization of landless women, and Lumanti, a support group for shelter. Details about those data and the data collection methodology can be found in the published reports [21], [22] and in an unpublished report [23]. Based on these reports, all the slums and their location were identified to prepare the preliminary version of the frame. This frame consists

of a list of names of all the slum settlements, their locations, year of settlement, the corresponding number of households, and the total population including gender disaggregation. Since those secondary sources of data were more than a decade old, they were unable to capture the current information about the slums. Current information about the formation of new slum settlements, splits in the old settlements, merger of the old settlements and formation of a new one, current household size, and population size of those slum settlements, were not available from those existing sources, so this preliminary version of the frame needs to be updated.

To prepare an updated frame for the study, a series of meetings were carried out in September 2019 with the information officer of 'Lumanti' and with the president, executive committee members, and officers of 'Nepal Mahila Ekata Samaj'. A field officer who has previously worked with 'Lumanti', and has good field experience of working in the slums inside the Valley was hired in October 2019 for thirty days. Three days of intensive training were provided to the field officer both by the researchers and the information management officer of 'Lumanti' about the procedure of collecting primary and secondary data.

The second list of slum settlements was prepared after coordinating with 'Lumanti', 'Mahila Ekata Samaj', and different ward offices of all the metropolitan city, municipality, and rural municipalities of the three districts of Kathmandu Valley. Once all those settlements were identified, they were listed based on different wards of concerned administrative divisions – Districts, Metropolitan City, Municipality, and Rural Municipality. New settlements and their locations were identified which were not previously mentioned in the report based on the studies carried out by 'Lumanti' and 'Mahila Ekata Samaj'. Newly identified slum settlements were added to the preliminary version of the frame. This procedure helped to update the existing list of slum settlements. Finally, in November 2019, an updated frame consisting of all the slum settlements inside the valley was prepared.

Once the updated frame was ready, in December 2019, a field visit was arranged to all those slum settlements and a meeting was held with the representative of those respective slum settlements to collect information about the number of households, the total population including the total male population and the total female population living on those settlements. Previously collected secondary data were verified and wherever necessary, changes to the preliminary version of the frame were made based on the information collected from the field visit. Finally, an updated frame was prepared which consists of the name of all the slum settlements and their location based on the local level administrative unit (wards), settlement year of the slum, the total male population, the total female population, the total population in respective settlements, and the total number of households on each settlement. Based on the National Population and Housing Census 2011, the total population of the concerned ward was also mentioned while preparing the updated frame.

The collected data was entered in Microsoft Excel. Descriptive statistics were computed suitably using StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP., and reported wherever necessary. Average household size and average sex ratios were also calculated for the comparison between /among different slum settlements. These findings were also compared with the national-level findings. The national-level findings on the population size, demographic information, and the parameters that are used in this research all were based on the National Population Census Survey, 2011.

A student trial version of Easy Fit software was used to explore the possible probability distribution of the slums among different wards inside the Kathmandu Valley. The information regarding the probability distribution of the slums will be highly applicable for designing the sample survey methodology to select the sample slums from the entire slums inside the Valley.

3. Results

Based on the study, it was found that the history of the settlement of slums and squatters in Kathmandu Valley goes back to 1969. In 1969, a squatter named Kimal Phant was settled in ward number 3 of Kathmandu

Metropolitan city which is considered the oldest settlement in the Valley. At present, there are 19 households in that settlement having a total population of 95. To date, across the Valley, the number of slums was found to be 12 and the number of squatters was found to be 49, and the remaining four settlements were not distinguished whether they are slums or squatters. It was found that all three districts of Kathmandu Valley have slums and squatter settlements, but there is a large variation in the number of slums and squatter settlements among those districts. There is also a large variation in the number of households, household size, population size, and sex ratio among those slums and squatter settlements. The number of slums and squatters was not uniformly distributed throughout the wards of different metropolitan cities, municipalities, and rural municipalities, and it was found that in some wards, there was an absence of slums and squatter settlements.

Among different metropolitan cities and municipalities in Kathmandu district, Kathmandu metropolitan city along with other five municipalities- Budanilkantha Municipality, Gokarneshwar Municipality, Khageshwari Manohara Municipality, and Nagarjun Municipality has slum and squatter settlements. Among these, Kathmandu metropolitan city has the largest number (39) and Nagarjun municipality has the least number (1) of slum and squatter settlements. Slums and squatters were also not uniformly distributed in every ward of the aforementioned metropolitan cities and municipalities. Eleven out of 32 wards in the Kathmandu Metropolitan City, four out of 13 wards in Budanilkantha Municipality, and one out of 13 wards in Gokarneshwar Municipality consist of slum and squatter settlements. There are nine wards in Kageshwari Manohara Municipality out of which only two wards contain slum and squatter settlements, and similarly, among 10 wards in Nagarjun Municipality, only one ward has such settlements.

Detailed information about the distribution of slum and squatter settlements in different wards of the aforementioned metropolitan city and municipalities along with household and population distribution in each slum and squatter settlement in the Kathmandu district is presented in Table 1.

Table 1. Distribution of Slums and Squatters throughout different Local administrative units of Kathmandu District

Ward Number	Total Population	Total Male Population	Total Female Population	Name of Slum/ Squatter	Slum/ Squatter	Settlement Year of Slum/ squatter	Number of Households in slum/ squatter	Total Population in slum/ squatter	Total Male Population in slum/ squatter	Total Female Population in slum/ squatter	Average Household size in Slum/ squatter	Sex Ratio in Slum / squatter
Kathmandu Municipality												
3	34,866	17,691	17,175	Radhakrishnachowk	Squatter	1983	18	106	55	51	5.89	1.08
				Ranibari	Squatter	1988	24	250	132	118	10.41	1.12
				Dhikure, Maharajung	Squatter	1981	23	133	55	78	5.78	0.71
				Pathivara	Squatter	1994	165	1,200	613	587	7.27	1.04
				Khadipakha, Maharajung	Squatter	1981	160	915	494	421	5.72	1.17
				Narayantole, Maharajung	Squatter	1981	33	192	97	95	5.82	1.02
4	47,362	23,788	23,574	Chandole, Bishalnagar	Squatter	1978	13	66	38	28	5.07	1.36
				Dhumbarahi, Sukedhara	Squatter	1978	6	34	21	13	5.66	1.62
6	60,344	30,472	29,872	Subigaon, Boudha	Squatter	1988	42	233	113	120	5.55	0.94
				Ramhiti, Boudha	Squatter	1971	129	750	356	394	5.81	0.90
				Mahankal, Bouddha	Squatter	1978	19	80	36	44	4.21	0.82
				Kumarigal, Boudha	Squatter	1993	11	73	38	35	6.64	1.09

7	51,581	26,561	25,020	Maijubahal	Squatter	1981	26	140	75	65	5.38	1.15
				Mitrapark	Squatter	1992	7	35	18	17	5.00	1.06
				Bulbulae, Chabhil	Squatter	1996	9	45	24	21	5.00	1.14
				Kalopul	Squatter	1994	6	30	15	15	5.00	1.00
				Sifal, Chabhil	Squatter	1984	2	9	4	5	4.50	0.80
9	40,371	21,277	19,094	Pragati Tole	Squatter	1971	28	140	71	69	5.00	1.03
				Gairigaon	Squatter	1996	44	222	120	102	5.04	1.18
				Chandani Tole	Squatter	1971	56	300	159	141	5.36	1.13
				Kalamati Dole	Squatter	1973	17	100	48	52	5.88	0.92
				Dirghayu Tole	Squatter	2007	60	335	183	152	5.58	1.20
				Mahabir Galli	Squatter	1973	15	210	111	99	14.00	1.12
10	39,820	21,110	18,710	Shati Binayak Nagar	Squatter	1988	36	260	138	122	7.22	1.13
				Shanti Nagar, Baneshwor	Squatter	1999	370	2,400	1,150	1,250	6.49	0.92
				Budhhamarga Tole, Sankhamul Devi Nagar	Squatter	1973	110	620	285	335	5.64	0.85
11	17,765	9,589	8,176		*	1981	42	214	111	103	5.12	1.08
				Thapathali Basti Banshighat	*	1981	258	1,100	672	428	4.26	1.57
11	17,765	9,589	8,176		*	1979	163	850	492	358	5.21	1.37
				Balkhu Basti	*	2006	361	1,800	928	872	4.99	1.06
14	58,495	30,942	27,553		*	2006	361	1,800	928	872	4.99	1.06
				Kumaristhan Buddhajyoti Marg Jagrititole, Balaju	Squatter	1993	75	425	205	220	5.67	0.93
16	84,441	44,030	40,411		Squatter	1976	150	850	418	432	5.66	0.97
				Annam Nagar	Squatter	1994	18	88	47	41	4.89	1.15
29	33,316	18,125	15,191	Sangam Tole, Samakhusi	Squatter	1977	37	201	96	105	5.43	0.91
				Jagriti Nagar	Squatter	2001	115	626	317	309	5.44	1.03
				Vijay Nagar	Squatter	1999	85	500	253	247	5.88	1.02
					Squatter	NA	150	878	487	391	5.85	1.25
32	76,299	40,530	35,769	Shanti Nagar	Squatter	1988	40	240	137	103	6.00	1.33
				Palpakot, Jadibuti	Squatter	1988	40	240	137	103	6.00	1.33
Budanilakantha Municipality												
4	5,204	2,591	2,613	Gairigaon, Gofultar	Squatter	1982	20	100	42	58	5.00	0.72
6	4,977	2,496	2,481	Khadka Bhadrakali	Squatter	1982	35	205	105	100	5.86	1.05
				Hattigauda	Squatter	1981	7	41	18	23	5.86	0.78
8	9,171	4,590	4,581	Mandikhatar	Squatter	1977	82	725	368	357	8.84	1.03
10	24,050	12,296	11,754	Kapan Dhungen, Kapan	Squatter	1979	17	75	35	40	4.41	0.88
Gokarneshwar Municipality												
3	5,467	2,702	2,765	Bahunechara, Jorpati	Squatter	1983	18	106	42	64	5.89	0.66
Kageshwori Manohara Municipality												
6	8,530	4,258	4,272	Mulpani Basti	Squatter	1993	15	65	28	37	4.33	0.76
7	10,031	5,058	4,973	Gokarana Mulpani	Squatter	1992	17	75	42	33	4.41	1.27
Nagargun Municipality												
7	4,470	2,202	2,268	Gairigaun, Mahankal	Squatter	1987	24	65	34	31	2.70	1.09

* Unidentified whether slum or squatter, NA = Not Available

The total number of households in slums and squatters in the Kathmandu district is 3177 and the number of people living in those slum and squatter settlements is 18202, having a total male population of 9377 (51.52%), and a total female population of 8825 (48.48%).

In the Bhaktapur district, Madhyapur Thimi Municipality consists of nine wards, and out of them, only two wards have slum and squatter settlements. The total number of households in slum and squatter settlements in Bhaktapur district is found to be 700 and the total number of people living in those slum and squatter

settlements is found to be 4800 having a total male population of 2854 (59.46%), and a total female population of 1946 (40.54%) as displayed in Table 2.

Table 2. Distribution of Slums and Squatters throughout different Local administrative units of Bhaktapur District

Ward Number	Total Population	Total Male Population	Total Female Population	Name of Slum/ Squatter	Slum / Squatter	Settlement Year of Slum / Squatter	Number of Households in slum/ squatter	Total Population in slum / squatter	Total Male Population in slum / squatter	Total Female Population in slum/squatter	Average Household size in slum/ squatter	Sex Ratio in slum/ squatter
Madhyapur Thimi Municipality												
2	9,880	5,209	4,671	Pragati Marg Manohara, Bhaktapur Lokanthali,	Squatter	2004	575	4,037	2,462	1,575	7.02	1.56
3	18,336	9,445	8,891	Manohara, Bhaktapur	Squatter	2003	125	763	392	371	6.10	1.06

Among different metropolitan cities and municipalities in Lalitpur district, Lalitpur Metropolitan City, Godawari Municipality, and Bagmati Rural Municipality have slum and squatter settlements. Ten wards out of 29 wards of Lalitpur Metropolitan City, one ward out of 14 wards of Godawari Municipality, and finally, one ward out of 7 wards of Bagmati Rural Municipality consists of slum and squatter settlements. The total number of households in slums and squatters in Lalitpur district is 819 and the total number of people living in those slum and squatter settlements is 5410 with a total male population of 2598 (48.02%), and a total female population of 2812 (51.98%) as shown in Table 3.

Table 3. Distribution of Slums and Squatters throughout different Local administrative units of Lalitpur District

Ward Number	Total Population	Total Male Population	Total Female Population	Name of slum/ squatter	Slum / Squatter	Settlement Year	Number of Households in slum / squatter	Total Population in slum / squatter	Total Male Population in Slum / squatter	Total Female Population in slum/ squatter	Average Household size in slum/ squatter	Sex Ratio in slum / squatter
Lalitpur Metropolitan City												
1	8,434	4,665	3,769	Gusinal	Slum	NA	34	362	162	200	10.64	0.81
4	15,367	7,580	7,787	Bagdole 1	Slum	NA	39	294	146	148	7.54	0.99
8	11,400	5,958	5,442	Lonhla	Slum	NA	40	242	125	117	6.05	1.07
9	13,908	7,385	6,523	Balkumari Chysal Khapichhen	Squatter Slum Slum	NA NA NA	17 24 22	72 282 256	32 114 133	40 168 123	4.24 11.75 11.64	0.80 0.68 1.08
12	10,349	5,301	5,048	Naudha, (Chakrabhil)	Slum	NA	17	160	79	81	9.41	0.98
13	14,867	7,400	7,467	Baddole 2	Slum	NA	15	90	38	52	6.00	0.73
14	21,232	10,518	10,714	Lohachowk	Slum	NA	84	420	192	228	5.00	0.84
19	7,385	3,779	3,606	Iti	Slum	NA	86	516	242	274	6.00	0.88
20	12,380	6,342	6,038	Nayagoan Ta Dhoka	Slum Slum	NA NA	46 30	273 146	126 80	147 66	5.93 4.87	0.86 1.21

22	5,966	2,981	2,985	Alko	Slum	NA	75	397	205	192	5.29	1.07
Godavari Municipality												
5	4,864	2,287	2,577	Nahar Battu, Godavari	Squatter	1971	235	1,600	782	818	6.80	0.96
Bagmati Rural Municipality												
7	2,299	1,156	1,143	Champi	Squatter	NA	55	300	142	158	5.45	0.89

NA = Not Available

Detailed findings of the slums and squatters' population, household, average household size, and average sex ratio along with their variations are mentioned in Table 4.

Table 4. Slums and squatters' population, household, average household size, and average sex ratio in Kathmandu Valley.

District	Number of Slum / Squatter	Total Male Population	Total Female Population	Total Population	Number of Households	Median of Average Household Size (Range)	Mean Sex Ratio (SD)
Kathmandu	48	9,377	8,825	18,202	3,177	5.57 (2.70-14.00)	1.05 (0.20)
Bhaktapur	02	2,854	1,946	4,800	700	6.56 (6.10 -7.02)	1.31 (0.35)
Lalitpur	15	2,598	2,812	5,410	819	6.00 (4.24 -11.75)	0.92 (0.15)
Total	65	14,829	13,583	28,412	4,696	5.66 (2.70 -14.00)	1.03 (0.21)

The majority of the slum and squatter settlements lie on the banks of different rivers, namely: Bagmati, Bishnumati, Hanumante, Dhobikhola, and Tukucha. All these rivers pass through different parts of the Kathmandu Valley. These settlements are highly affected by the polluted environment and the risks of floods. Bagmati River consists of eleven slums, namely: Shanti Nagar, Vijay Nagar, Jagrit Nagar, Gairigaun, Chandani Tole, Pragati Tole, Kalimati Dole, Kimal Phant, Banshighat, Thapathali, and Sankhamul. Bishnumati river consists of ten settlements on the bank of the river, namely: Dhikure Chouki, Kumaristhan Buddhajyoti Marga, Balaju Jagriti Tole, Sangam Tole, Ranibari, Inyatole, Ramghat, Hyumat, Dhaukhel, and Bhimmukteshwor. Hanumante river contains only two settlements, namely: Pragati Marg, Manohara, Bhaktapur, and Lokanthali, Manohara Bhaktapur. Dhobikhola river contains five settlements, namely: Shanti Binayak, Devi Nagar, Bishal Nagar, Kalopul, and Pathivara. Two settlements are situated on the bank of the Tukucha River, and they are Narayan Tole Maharajung and Khadipakha Maharajung. The remaining other settlements are situated in other parts of the Valley [22].

Among the ten settlements based on the Bishnumati river five settlements namely: Inyatole, Ramghat, Hyumat, Dhaukhel, and Bhimmukteshwor people refused to include their settlements under the slum and squatter settlements. At the time of the field survey, those settlement community people claimed themselves as an indigenous group belonging to a Newar community and they were more interested to name their settlements as Indigenous Settlements. Those Indigenous Settlements were not included in the present study. The total number of households and the total population of those Indigenous Settlements were found to be 109 and 517 respectively [21].

Among sixty-five slums and squatters, Pragati Marg, Manohara, Bhaktapur, situated in ward number 2 of Madhyapur Thimi Municipality is the largest one with 575 households having a total residential population of 4,037, whereas Sifal, Chabahil situated in ward number 7 of Kathmandu metropolitan city is the smallest one

with only two households having total residential population nine. As displayed in Table 4, there is a high variation in household size, household population size, average household size, and sex ratio in those slum and squatter settlements.

Among those three districts, Kathmandu district consists of the maximum number of slums and squatters (48), followed by Lalitpur district (15), and Bhaktapur district (2) respectively. In total, there are 65 slum and squatter settlements in the Valley, with total households of 4,715, and a total population of 28,507.

Wide variation was found in the average household size among the different slums and squatters located in the different parts of the Valley and are shown in Table 1, Table 2, and Table 3. Mean household size was found to be highest (14) in ward number 9, Mahabir Galli of Kathmandu metropolitan city situated in Kathmandu district, and least (2.70) in ward number 7 of Nagargun municipality situated in the Kathmandu district.

Among sixty-five slums and squatters, Bahunechara, Jorpati situated in ward number 3 of Gokarneshwar Municipality of Kathmandu District has the minimum sex ratio and was found to be 0.66, whereas Dhumbarahi, situated in ward number 4 of Kathmandu municipality, has the highest sex ratio and was found to be 1.62. There is a high variation in sex ratio among the different slum and squatter settlements in the Kathmandu Valley.

A large variation in the number of households (2 to 575) was found in those slum and squatter settlements inside the Valley. The total number of slum settlements inside the valley was found to be 65 with a total number of households of 4,696, a total population of 28,412, having a total male population of 14,829 (52.20%), a total female population of 13,583 (47.80%). A wide variation in the total population size (9 to 4037) was observed in those settlements. Median of average household size and mean sex ratio was found to be 5.66 (2.70 to 14), and 1.03 (SD = 0.21) respectively. Summary of the findings is presented in Table 4.

3.1 The probability distribution of slums and squatters in the Valley

In Nepal, we have a local-level administrative unit known as a “ward”, and there are 247 such wards inside the Kathmandu Valley [7]. In this analysis both the slum and squatter are treated as slums because of having similar types of characteristics. It has been reported that there is an absence of slums in more than four-fifths of the total wards, and the distribution of the number of slums among the wards is highly skewed (Coefficient of skewness = 4.66). The distribution of slums across the wards has indicated that the event of identifying the slum is a rare event among these wards and is displayed in Table 5. The average number of slums in the ward is reported to be 0.267 with a variance of 0.7975.

Table 5. Frequency Distribution of Number of Slums in different wards inside the Kathmandu Valley

No. of <i>slum</i>	Frequency (%)
0	214(86.64)
1	19(7.69)
2	7(2.83)
3	1(0.40)
4	3(1.21)
5	1(0.40)
6	1(0.40)
7	1(0.40)

Based on exploring the nature of the reported number of slums across the wards of different local administrative units of Kathmandu Valley through the shape of the histogram as illustrated in Figure 2 has indicated that the number of slum distribution follows a Poisson probability distribution.

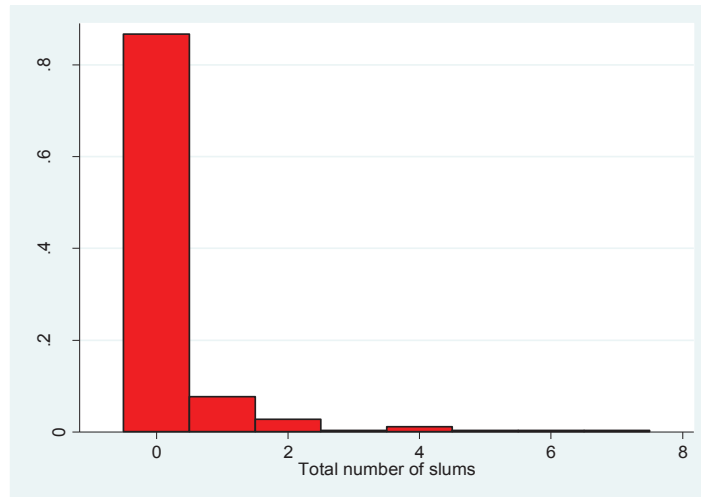


Figure 2. Probability distribution of the number of slum

3.4 Fitting of the Poisson Probability Model

Let μ be the rate of occurrence or the expected number of times a slum will occur under our consideration. Let y be a random variable representing the actual number of times a slum occurs in the wards. The relationship between the expected count μ and the probability of observing a slum count y can be represented by the probability density function of the Poisson distribution as follows.

$$P(y | \mu) = \frac{e^{-\mu} \mu^y}{y!}, \quad y = 0, 1, 2, \dots$$

To test the goodness of fit of the Poisson model for the number of slums, the expected frequencies are computed using the Poisson probability function as follows.

$$e_i = N \frac{e^{-\mu} \mu^y}{y!}, \quad y = 0, 1, 2, \dots ; \quad \text{Where } N = \sum_{i=0}^7 f_i$$

The goodness of fit of the model was assessed through graphical presentation and statistical tests. The closeness of the observed and expected frequencies computed through the Poisson probability density function has been assessed through the graph of observed frequency and expected frequency is represented in Figure 3. It can be observed that there is closeness in the observed and predicted frequencies in the majority of the data points except for $y = 0$ and 1 each. For $y = 0$ it is slightly underestimated while for $y = 1$ it is slightly overestimated.

Further, the test of goodness of fit of the model was evaluated by using the Anderson Darling test and Kolmogorov Smirnov test by using EasyFit software. As displayed in Table 6 both the tests, Anderson Darling (Test statistic = 174.02) and Kolmogorov Smirnov (Test statistic = 0.76551) have indicated a better fit of this data by Poisson distribution comparatively among explored other discrete distributions such as Uniform and Geometric probability distributions. Among these explored discrete distributions, the Poisson distribution can be considered comparatively the better choice based on the results of the goodness of fit statistics, rare nature of the occurrence of events, and the shape of the distribution though there is considerable overdispersion ($\mu = 0.267, \sigma^2 = 0.7975$).

Table 6. Results of the goodness of fit for the number of slums

Distribution	Kolmogorov Smirnov Test	Rank	Anderson Darling Test	Rank
Poisson	0.76551	2	174.02	1
Geometric	0.78914	3	191.79	3
Discrete	0.66667	1	182.87	2
Uniform				

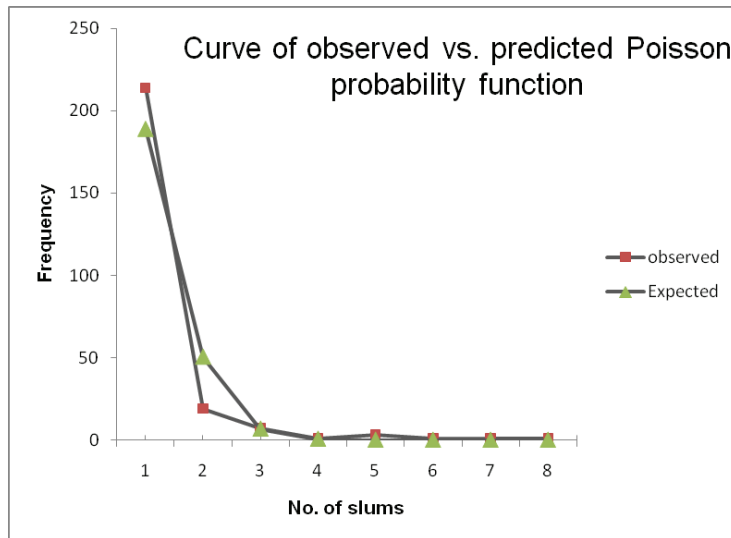


Figure 3. Graphical representation of Poisson probability distribution

4. Discussion

On the one hand, identification of slum and squatter settlements is a challenging task, and on the other hand, detailed data on slums and squatters dwellers are not easily available, and even if they are available, they are not consistent among the different available sources [4]. Accurate measurement of the size of a slum is always a difficult task due to many reasons such as inconsistencies noted in definitions, due to the change in the definition of slum over time, technical difficulties in the enumeration of slum population, many slum communities are not officially declared by the government, and overcount of slum population due to political interest [12].

Till now, a specific survey on slum settlements has not been organized by the Nepal government, so it is very difficult to get the current and updated accurate government information about the slums, slums households, slums population, and different demographic components of the slum settlements. Certain non-governmental organizations working on the slums issues have conducted a few surveys on slums for their purpose, but the findings are not consistent among them. The findings of those surveys reflect the similarity in some dimensions while findings on the other dimensions differ. Key findings based on this study are discussed in the subsequent paragraph.

The global population of slums is on the increasing trend, and Nepal is no exception in this matter. Discussion on the history of the slum and squatter settlements inside Kathmandu Valley is relatively a noble topic for academic research. The size of the slum and squatter settlements in the Valley is relatively small when comparisons are made with the slum and squatter settlements belonging to the other cities of South Asia, and most of the cities belonging to the rest of the world [1]. A variation on the definition used for the identification of slums and squatters along with variations on different demographic parameters on slums and squatters' measurements were also observed. In the Nepalese context, different studies have suggested a different number of slum settlements, households, and slums population sizes inside the Valley. The total population living in slums and squatters increased from an estimated 11, 850 in 2000 A.D. to 5, 00, 000 in 2010 A.D., and still, there is a lack of sufficient, reliable, and comparable data on slum settlements [26]. The Kathmandu Valley's informal settlers and settlements have grown in numbers from 17 to 40 from 1985 to 2008, while another study suggests that the number of such settlements is 70. The population of the squatters' settlements has increased from 7,791 to 16,953 within 10 years from 2000 A.D., and further, it is mentioned that if the current trend of population growth rate remains constant, the population in those settlements will reach 38,262 in 2024 A.D [36]. It was reported that there were 55 slum and squatter settlements, 3,436 households, and 29,867 population living in those slums in the Kathmandu Valley [28]. Before 2006/7 A.D., 40 squatters, and

five indigenous settlements with a total number of households of 2,844 and a total population of 13,243 were found in the Valley [22]. A joint survey carried out in 2013 by two Nepali NGOs, found that there were 4,035 households, and a total population of 24,021 residing in slums and squatters in the Valley [23]. Based on the findings of the study there were 2,735 households with a total population of 12,726 living in the slums and squatters inside the Valley [3]. There were 39 squatter settlements and 137 slums in the Valley with a 40,237 population and 8,846 households [18]. All these findings from different studies carried out by different organizations over a different period of time are not consistent with each other. One of the reasons for these inconsistencies in findings might be due to the use of the different operational definitions of slums used by different organizations in their study.

According to this study carried out in 2019, there were 4,696 households with a total population of 28,412 having a total male population of 14,829, and a total female population of 13,583 living in the slums and squatters in the Valley. These findings are larger than the findings of the other study [23]. This shows that the numbers of households, as well as the slums population, are in an increasing trend over time.

The total population of Kathmandu, Bhaktapur, and Lalitpur is 2,517,023 [5]. Based on this study carried out in 2019, it was found that the total number of people living in slum and squatter settlements in these three districts is 28,412. This slum population is 1.13% of the total population and this percentage is smaller compared with the rest of the world [1].

A large variation in the average household size among the different slum and squatter settlements situated in different metropolitan cities, municipalities, and rural municipalities was found in this study. This type of variation was also found in the previous two different studies [21], [22]. The pooled average household size of slum settlements was found to be 4.7 [22], whereas in another study it was found to be 5.3 [21]. In this study the median of the average household size was found to be 5.66 which is larger than the findings of the National Population and Housing Census, 2011 carried out by the Nepal government [6] and other previous studies [21], [22]. The average household size varies among different castes. The average household size of Muslims was reported to be 6.5 persons, Madhesi 6.0 persons, Newar 4.5 persons, and hill Brahmins 4.2 persons, and at the national level, the average household size is 4.88 [5]. This shows that the average household size in slums is higher when compared with the national level findings.

In this study, it was found that the sex ratio was not uniform among the different slum settlements located in different districts, metropolitan cities, municipalities, and rural municipalities. Based on the present study, the sex ratio in the slum settlements was found to vary from 0.66 to 1.62, whereas according to the survey carried out in 37 different settlements of Kathmandu Valley, the sex ratio was found to be 1.042, but in another survey carried out by the same organization in July 2007 on 40 different slum settlements, it was found to be 1.08 [22]. At the national level, the sex ratio was found to be 0.94 (94 males per 100 females) [5]. The mean sex ratio was found to be the smallest (0.92) in the Lalitpur district and the largest (1.31) in the Bhaktapur district as mentioned in Table 4.

The distribution of slum and squatter settlements across 247 wards of Kathmandu Valley seems to be following overdispersed Poisson distribution. For the theoretical Poisson distribution, the mean and the variance are equal, but in practice, the count variable has often a variance greater than the mean i.e., the presence of overdispersion, and there is also the possibility of having under dispersion, not exactly equi-dispersion [20]. Based on the data, the variance is almost more than three times as large as the mean ($\mu = 0.267$ and $\sigma^2 = 0.798$) with a clear indication of overdispersion. Even having overdispersion, the

curve of the observed and predicted frequencies of the Poisson distribution seems to be closure except for two data points at the beginning of the distribution, and the nature of the curve is theoretically matching with the curve of the Poisson distribution. Moreover, the test of goodness of fit of the Poisson distribution is also reasonably justified through the Kolmogorov Smirnov test and Anderson Darling test.

5. Conclusion

Defining slums and their characteristics is a very challenging task. The Nepal Government has not provided any specific definition, characteristics, and complete information regarding slums. Some Nepali NGOs have addressed them but they lack scientific rigor. Various names were identified and they are interchangeably used for naming the slum. Different studies carried out by different organizations in different periods showed that the number of households and slum population inside the Valley is found to be on an increasing trend. Kathmandu district has the largest number of slum and squatter settlements, and the population living in slums and squatters followed by Lalitpur and Bhaktapur districts. The distribution of slums across 247 wards of local units of Kathmandu Valley seems to be following overdispersed Poisson distribution.

This study is mainly based on secondary data and they were further verified by the people's representatives of concerned settlements. This limitation can be overcome by regularly conducting a population and household survey on the slum settlements by some government or non-governmental organizations. This is possible only when the government will formulate a specific policy for conducting a regular population-based survey in the slums.

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