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C O N T E N T

State of Solid Waste Management Challenges as Exacerbated by COVID-19 Pandemic Related Littering in Addis Ababa City Administration.

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Abstract : This study was concerned in the examination of state of solid waste management and the challenges related to exacerbation of COVID-19 attached littering in Addis Ababa city administration .The study explored the challenges and effects of COVID -19 in one of the areas/sector where the environmental impacts of the pandemic are most prominent, the solid waste management sector.A total of 455 survey questionnaires were distributed and collected with a response rate of 100% from under 7 sub-cities considering some specially identified problematic areas which are known to have recurrent unattended littering problems due to human& economic activities as pathway. A mixed cross sectional survey research approachwasusedwith structured questionnaires, reconnaissance survey& sideline interviews administered as primary source of data collection. As one prime focus/objective of the studyis to assess and evaluate the magnitude of the problem of the challenges resulted due to COVID -19 pandemic on the solid waste management.Likert scale type survey questionnaires were administered which wereanalyzed quantitatively by using mean score and percentages.The result shows that, the challenges and magnitude of the problems resulted due to COVID-19 pandemic to exacerbation of littering rise on the solid waste management /SWM and on the overall aspects of the sector was found to be a moderately significant as having or acquiring an average mean score value of 3.42 or (68.46%).Considering the full extent of the problem in terms of the computed percentage amount, this may probably sound in a justifiable sense that, the magnitude of the problem of the challenge of COVID-19 on the SWM sector had been by about 68.46%during the tough times of the COVID-19 pandemic.

Key words: Littering, Covid-19,SWM, Personal Protective Equipment, single use items

Background of the study

According to International Finance Corporation estimate, (2020) every year the world generates over 2 billion metric tons of municipal solid waste.

The World Bank assessment likewise predicts that by 2050 global annual waste generation will increase by 70 per cent—to 3.4 billion metric tons. According to the same source in low-income countries, the extent of waste is expected to increase threefold by 2050, mostly in sub-Saharan Africa. As a consequence of this rapid growth of waste generation, there has been serious challenges prevailing in low income or emerging economies.

COVID -19 is an emerging global pandemic over the last few years since its outbreak that has been affecting in unprecedented way almost all areas of the globe broadly which needs cross-cutting intervention. The economic, social, health and environmental costsand damages caused/resulted due to COVID -19 are considerably high.The adverse effects of COVID-19are being sensed in different sectors of the economy globally affecting the smooth functioning of different socioeconomic activities.

In this sense, the waste management sector is not exception as one of the sector that has felt the effect of the burden considerably.Waste management is an important municipal activity that

affects the human health and the environment.Thus, waste management is an essential public service required to contain the spread of different epidemics such as of COVID-19 (UNEP, 2020). Following immediately the outbreak of novel Corona virus(COVID-19) since 2019 a growing body of literatures both published and unpublished indicate that due to the associated mandatory protective/ preventive safety measures implemented globally that include social distancing and lockdown, there has been increasing quantity of waste and environmental pollution. As a consequence of this, globally there has been wide spread use of personal protective equipment that has resulted in the discarding of uncontrolled single used protective equipment waste affecting the quantity adding an enormous increasing amount of littered waste changing the scenario of waste management.

According to WHO (2020)there has been a growing potential widespread discarding, open burning and incineration practices that could affect air quality and health outcomes due to the exposure to toxins . Also, there could be a severe implication and impact for developing countries without standard waste management technologies and waste emergency policies to curb the pandemic. Unmanaged littered personal protective equipment waste is particularly concerning due to its implications to natural ecosystems and public health and safety.

Like most other developing countries, the government of Ethiopia and the city administration of Addis Ababa is being challenged by the low participation of the public, ignorance and the low level of attention and understanding of the public to the adverse effect of COVID -19 preventive equipment related waste, unavailability of proper facilities for collection and disposal of communal COVID-19 generated waste to entire city inhabitants due to also low municipal capacity and absence of predefined responsibilities.

In the context of developing countries like Ethiopia along with the lack of proper/poor environmental monitoring and inspection, lack of proper handling problem, awareness and ignorance, well informed inhabitants of environmental law and effects of COVID 19 related waste as emerging issue and the lack of COVID -19 related enabling institution to determine how far activities are carried out
In the COVID time the city government is not still providing separate waste collection facilities. As a result, a lot of dangerous items (such as discarded masks and other healthcare wastes,and potentially infected &contaminated items) may cause risks of contamination or poisoning, particularly to scavengers and school going children.

The lack of proper SWM practice, coordination and awareness and cross cutting intervention are also key gap identified in the existing COVID-19 related waste management.

Another observable common issue is that the existing waste collection, treatment and disposal technologies, options & facilities to Covid-19 pandemic related waste are not well designed, well-built and well managed in the study areas. In addition to this, the present state of waste management practice has limited compliance to environmental health standards and health care waste stream guidelines.

Currently, more than ever, following the outbreak of COVID 19 around many parts of the world ,especially in urban centers, there has been wide spread unpleasant infectious municipal waste littering in public places caused by personal protective equipment /PPE discarded materials as there has been restrictive measures imposed to use the equipment as critical issues. These days more than ever in the study area, Addis Ababa, the area coverage and volume of COIVD -19 related littering of solid waste is significantly on the rise like many other urban centers of least developing related to the crisis.

Materials and Methods Research Design

The design of the research is cross-sectional survey study using descriptive and explanatory research design where a mixed research approach was employed to collect data from a total of 455sample respondents of which 352 were selected by using multistage stratified randomly sampling techniques from commercial and residential centres while the rest 103 were respondents from institutions. For the selection of the representative sample respondents from the target population(commercial, residential, hotels and cafes respondents), Kerejice and Morgan table of sample selection was used.

Sample size and Sampling Technique

The unit of analysis for the study constitutes residents found in most problematic enumeration sites/districts. They include busy pathways, commercial and residential neighborhoods and actor institutions that are found in the most affected and problematic sub cities. These areas are characterized by high vulnerability of waste littering that encompasses also private waste collection enterprises and rag pickers, including households. The sampling frames for the study were selected from seven identified enumeration sub-cities of the study area.

In this context, based on geographical orientation from among the existing actual 10 sub-cities of AA, by using simple random sampling technique from each, one representative sub city was selected. In this respect from among the five clusters(north, south, east, west and center), Arada sub-city representing north, Yeka & Bole from east, Addis-Ketama representing west sub-city, Kerqose from central Addis Ababa and Akaki-kality from south were drawn or included purposively. The sample size of each cluster sub city and the targeted woreda were determined based on Krejcie& Morgan's (1970) tableof sample size determination.

In this context from among the seven selected sub cities, some 10 woredas /districts which are most problematic and vulnerable to uncontrolled and rampant generation of waste are identified with the assumption that these parts (woredas) of the city are commercial and business centres where there is a high mobility of people due to presence of some facilities and infrastructures such as bus terminal and taxi station. Based on statistical data reference from the AA, city ATLAS (2015GC/2007EC) the total population residing in the selected woredas was reported as close to 200,000.

Accordingly, the sample size of each cluster sub city and the targeted woreda for the residential questionnaire was determined based on Krejcie & Morgan's (1970) table sample size determination rule of thumb where **N =193,038 S** that is the required sample size is 377.

In addition to this, a questionnaire was distributed to randomly selected experts and work unit heads/coordinators working in AA city administration/ institutions, some federal level institutions that have stake in waste management, urban sanitation health, environment protection and private waste operators.The relevant sectors/ institutions were selected purposively by using non-probability sampling technique and drawn from among relevant federal, city and sub-city level targeted institutions. Accordingly, some 78 purposively selected sample respondents were involved. Hence, the desired sample size for the present survey in total was455(377+78).

In addition to this, for the categorical data that was collected from the different schedule interview platforms such as face to face structured interviews of human inquiries.Some 30 interviews were considered for such a data base.

Table 1: Krejiec& Morgan: Table of Sample Size Determination

Table for Determining Sample Size for a Given Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Source: Krejcie & Morgan, 1970

Data Source and Data Collection Instruments

In search of addressing, the research objectives all reasonable efforts were made by carrying out primary data that was collected by employing interviewer administered survey questionnaires platform, structured interviews, and field reconnaissance observations and based on desk review from secondary data/sources**.**

In an attempt to properly collect the necessary data from the survey respondents, a five point Likert scale was designed where the final obtained result was analysed and compared with mean score delimited by Zaid Aton and Bagheri (2009).

For field based data collection purposes, multiple data gathering techniques/ instruments were used. The largest proportion of the data were collected and generated from primary sources i.e.survey questionnaire is one key instrument. For the collection of relevant secondary data for each thematic area a checklist was used.

The field investigation and monitoring activities were carried out systematically and reasonably through field observation and visits of the different potential litter source sites by using a checklist. The household level survey questionnaires for the intended purpose were distributed based on the administrative layers /arrangement that follow city, sub-city and woreda level.

The questionnaire was administered by using self-administered and interviewer administered approaches. For the greater majority of the survey respondents from the commercial, hotels and restaurants and residential including street vendors an interviewer administered mixture approach was employed. For public institutions and key actors as most are known tobe literates, a self-administered approach where the participants filled-up the questionnaires ~~were~~ was employed.

The questionnaire was pretested and validated by a post-test and a pilot survey was conducted with a sample of 60 respondents, with representations from the various strata of the study respondents. The study instrument generally has seven sections comprised of 6 questions for assessing the socio demographic back ground of the participants, 7 questions for assessing current aspects of solid waste management, 9 questions designed for assessing littering aspect, 6 questions on solid waste, reusing,recycling and recovering aspects, 5 questions for assessing SW handling and segregation aspects(technical issues) and the last part of the questionnaire, part 7 focused on assessing the subsequent impacts of COVID-19 pandemic on the waste management sector comprising of 11 questions in total.The questionnaire consists of a kind of Likert type questions with agree/disagree/no not sure/somewhat responses and with yes/ no and sometimes responses.

The Interview and Interviewees Background

To supplement/complement the quantitative data from the survey questionnaire, a thorough data was gathered, in in-depth and extensive face to face and telephonic interviews were conducted

from among the potential key informant participants. The study for the interview made use of an interview guide/ or schedule supported by a checklist designed in the structured interview strategy/technique covering of comprehensive thematic inquiry.

The interview schedule was designed in English language that was administered /presented to the interviewees directly by translating the main points of the themes in Amharic language. Then the recorded audio interview notes and handwritten interview notes were translated into English language, categorized with codes according to the thematic areas and the variables.

The participants for the interview were drawn from among the existing key SWM actors and stakeholder institutions of the study area selected by using purposive sampling technique that involve also snowballing techniques.

In the interview session, a total of almost 30 participants had participated that were recruited on voluntary basis. In this regard in both the face to face and telephonic interview secessions exhaustive data were gathered from each sub-city SWM office heads and work unit coordinators,such as AASWMA, EPA,EEFRI (Ethiopia, Environment& Forest Research Institute) representatives from each sub-city private-public partners and enterprises and operators in SWM.

Prior to imparting the interview authentication and permission letters were submitted, where the participants were all confirmed that personal profiles and bio-data such as names including their interviews are confidential and will not be revealed as individual report officially. The identity of the study participants' was retained anonymous at several phases of the study.

Data Analysis Methods

The type of data analysis method employed in the present study included only a group of descriptive statistics using frequencies, measures of percentages, measures of variance, range, mean where the results of the study are presented by using table, figures and graphs .The reason for carrying out only descriptive statistics only was partly with the research objective as it is primarily and essentially interested to investigate on current status of the problem and the comparative situation of the selected sites. Hence, the issues being dealt are still existing, on-going and prevailing that could be adequately dealt or analysed with the application of a family of descriptive statistics.

In an attempt to properly collect the necessary data from the survey respondents a five point likert scale was designed. The final obtained results were analysed and compared with mean score delimited by Zaid Aton and Bagheri (2009).

According to these scholars the mean scores are classified and organized the respondents into three different categories organized as <3.39 low indeed poor or, 3.40 to 3.79 moderate and sufficient and > 3.89 as high and good enough. Along with this, the attempt to compute and analyse descriptively from the Likert result/value was done based on the five point Likert scale by converting the result obtained. The frequencies were then converted into percentages to ensure comparison and contrasts. The details of the analysis based on the score points are presented in table-2.

Table 2: Standard table for analysing the Likert type results to determine the condition or statusof SWM

Low/poor/inadequate/not adequate enough/insignificant	Moderate/medium	High/good enough/sufficient enough/significant
≤ 3.39	3.40 – 3.79	≥ 3.8
≤ 67.8%	68% - 75.6%	≥ 76%

Source: Zaid Aton and Bagheri (2009); Yalegama, Chileshe, & Ma (2016)

Finally, to analyse the collected quantitative data in line with the overall objective of the research, statistical procedures were adopted by using Statistical Package for Social Science (SPSS) version 25. The qualitative data that were collected from the different subsequent interview schedules and, desk review & field observations were processed and analysed thematically. The data that had been obtained from directives, proclamations and reports were analysed by using content analysis method.

Result and Discussions

Table 3: Survey Questionnaire Distribution areas and sample respondents taken from sectors &Actors

S/N	Actor sectors	Institution	Frequency	Sub-city Yeka, Arada, Gulele,Kirkso, Addis Ketema, Bole, and AkakiKality							
1	Public institutions AA city SWM agency	All the three work units staff in SWM	61								
2	AA city EPC										
3	Sub-city Sanitation/SWM administration office	• Community mobilization and awareness work unit • Reuse and recycling work unit • SW transportation	70								
4	Commercial centers, street,		265								
5	Residential areas		65								
6	Hotels ,cafes& restaurants		26								
	Total	**455**									

Source: Field survey,2021/2022

Table 4: Overall Demographic Characteristics of Survey Respondents

		Frequency	Percent
Gender	Male	316	69.5
	Female	139	30.5
	Total	**455**	**100.0**
Age average	18-30	266	58.5
	31-40	174	38.2
	41-50	10	2.2
	51-64	4	9
	64 & Above	1	2
	Total	**455**	**100**
Education Status	Illiterate	11	2.4
	Read & Write	12	2.6
	Some Primary School	48	10.5
	Some Secondary School	94	20.7
	Diploma	59	13
	Degree	194	42.6
	MA Degree	37	8.1
	Total	**455**	**100**
Institutional Affiliation	Residential areas	65	
	Commercial centers & street vendors	265	
	Public institutions	78	17.14
	Hotels & Restaurants, cafes	26	5.7
	Total	455	100

Source: Field survey result (2021/22)

List of Interview Participants

The relevant actors for interview were selected based on purposive non probability sampling technique. The selection of relevant KII from among the selected institutions was under taken purposively in steps. First, the list of relevant work units/office was identified .Then the list of teams and staff registered in the work unit and institutions including their phone number were identified and cleared where by valid individuals were selected for the purpose

Table5: List of Interview Participants

Related sectors	Area/institution interview administered	Participants position	Number of interview questions	Remarks
AA city SWM Agency	2	Swm expert	10	
Yeka sub-city Sanitation administration office head& enterprises involved in SWM	3	Three work unit heads of swm	10	
AA city Environment protection Authority and forest development and research institute	2	Senior experts	10	
Gulele sub-city Sanitation administration office head and SW enterprises/partners involved	3	Three work unit heads of swm	10	
Arada sub-city Sanitation administration office head and enterprises/partners involved in SWM	3	Three work unit heads of swm	10	
AddisKetamasubcity Sanitation administration office	3	Three work unit heads of swm	10	
AkakaiKaliti sub-city Sanitation administration office head& enterprises involved in SWM	3	Three work unit heads of swm	10	
Kirkos sub-city Sanitation administration office head & enterprises	3	Three work unit heads of swm	10	
4involved in SWM				
Yeka sub city Sanitation administration office head & enterprises involved in SWM	3	Three work unit heads of swm	10	
Informal waste pickers(rag pickers)	4	Individual informal waste pickers	5	
TOTAL	**29**			

Source: Field survey,2021/2022

Current state of management of solid waste in the midst of COVID-19 pandemic

In order to measure this research question, the respondents of the survey were required to rate genuinely the all-encompassing statements of attributes or dimensions and the real situation based on their rational mind, acquaintance and intuitive experience and skills to detect. From the mean score analysis result depicted in Table -6 below. The overall result was computed and compared by calculating the average mean score based on mean score analysis standard as given by Zaid Aton and Bagheri (2009). In this respect ,as depicted in the same table below ,the overall mean score analysis result is 2.87 much lower value than the cut-off point that explicitly implies and sounds like literally, the current state of SWM is significantly at deeply worrying condition or inappropriate status having excessive and in big question at all as the computed mean score value

is much lower and that may sound if not in a justifiable sense that like it is not in good enough condition as the mean score value is below the cut-off point .

In realizing and interpreting the result of the mean score value based on the computed all-encompassing statements of attributes or the dimensions, it is indicative of automatically that, the current SWM condition is not in better well deserving condition that may also imply literally there is a real problem as the result is not promising and encouraging.

Table No. 6: DescriptiveStatistics Result on Respondent Insight Agreeing on State of SW

Statements of Attributes/Items	N	Minimum	Maximum	Mean	Intensity/degree	Std. Deviation
1.How would you rate the overall municipal solid waste management aspect (planning, financial ,legal & institutional aspects)?	455	1	5	3.31 (66.2%)	Low	.935
2.How would you rate the existing municipal solid waste management institutional capacity and arrangements?	455	1	5	3.26 (65.2%)	Low	.816
3.How would you rate existing municipal waste management in terms of comprehensiveness of existing laws and regulations?	455	1	5	2.76 (55.2%)	Low	.880
4. How would you rate municipal waste management services in terms of effectiveness of enforcement of laws and regulation in addressing waste issues?	455	1	5	2.69 (53.8%)	Low	.886
5.How do you rate Waste Management service in terms of public awareness	455	1	5	2.76 (55.2%)	Low	.880
6. How do you rate existing municipal SW service being provided in terms of effectiveness	455	1.0	5.0	2.69 (53.8%)	Low	.88259
7. How do you rate the existing solid waste management practice in terms of safety to the protection of the environment and to safeguard human health and wellbeing?	455	1	5	2.63 (52.6%)	Low	1.720
Valid N (listwise)	455					
Overall mean				**2.87 (57.4%)**	**Low**	

Source: Field survey, 2021/2022

Interestingly, the field observation result somewhat reflected congruence that, the existing solid waste management of the study area under the COVID –19 periods was not proper as the collection of potentially infectious COVID-19 related waste had been noticed mixed with the general waste together. Likewise,based on the field walk through observation in the different enumeration study sites, it was noticed that the transportation routing of the vehicles carrying SW and the handling of all fresh waste items is improper where the normal public road is being used for hauling without covering that is causing sometimes odour and litter into the streets/ground.

The level and trajectories of littering situation of solid waste due to exacerbation of Covid-19 pandemic adverse effect

In order to address or detect this research question, the respondents of the survey were required to evaluate the real situation issue by applying genuinely their rational mind, acquaintance and intuitive experience and skills

Likewise, this was also confirmed from the side-line interview secession and walk through observation data collection strategies that the existing SWM, the collection and disposal is not based on international and national guidelines and procedures of hazardous and health care waste management that has the potential riskAnother outstanding areas of observation noted during walk through field observation was the improper management and handling of COVID-19 related litters and refusal with other general waste.

Table 7: Insight of survey respondents on prevalence of litter& refuses around their neighbourhood/locality /city in relation to COVID19 Pandemic?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	155	34.1	34.1	34.1
somehow	221	48.6	48.6	82.6
3. Never	78	17.1	17.1	99.8
Total	455	100.0	100.0	100.0

Source: Field survey, 2021/22

The result as depicted above in Table-7concerning the existence of COVID-19 related waste indicate that a little lower than half of the respondents, 48.6% (n=221) from among 455 survey respondents have dominantly affirmed somehow on the prevalence of litters exacerbation level. But a considerable number of respondents 34.1% (n=155) rated or affirmed the presence of litter and refusal related to COVID-19 around their neighborhood and the entire city. On the contrary 17.1 percent declined or chose to remain never.

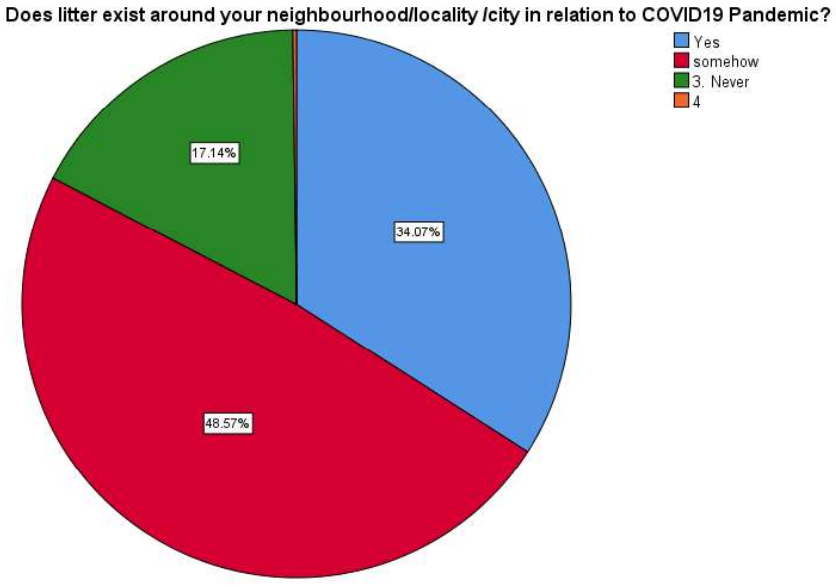

Table 8: Insight of respondents on the dominant types of litter item occurrence in the midst of COVID?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Papers, sanitary pads &cartoons packaging's	161	35.4	35.4	35.4
Face masks, plastics dis indicant bottles	207	45.5	45.5	80.9
Clothes &shoes	22	4.8	4.8	85.7
Scrap metals& electronics	14	3.1	3.1	88.8
Glass	3	.7	.7	89.5
Other specify	48	10.5	10.5	100.0
Total	455	100.0	100.0	

Source: Field survey, 2021/22

The result as outlined in Table-8literally it indicates that most significantly face masks and COVID-19 related Personal protective items equipment /PPE/ are identified as the most dominant litter items and refuses dropped on the ground and into the environment as it is observed and rated by a little fewer/lower than half of the respondents, 45.5% (n=207) followed by papers ,sanitary pads and cartoon packaging items as rated by 35.4%(n=161) of the survey respondents. One of the most important effects of the pandemic seen presently globally is in unprecedented use and generation of potentially contaminated face masks, gloves and PPE which have been discarded inappropriately littered in public places and the environment. In terms of this, several studies have confirmed that after the out broke of the pandemic, the increasing use of masks and gloves has led to the rise in urban litter (Kalina and Tilley 2020).Based on the result of the table and the figure as mentioned above, it reveals that face masks are the most discarded common personal protective litter item pilling up rated as having medium (45.49%) during the pandemic which has increased during the time.

Much of previous studies that have been conducted in several countries have also concurrence result on the situation that following the outbreak of COVID-19 a significant increase on the amount of face masks and PPE post used material litter was widespread phenomena in most parts of the world.

Table 9: Insight /Percentage of respondents on the extent and level of litter and refuse occurrence/prevalence situation since the outbreak of COVID19 around their areas of Premises, neighbourhood/city?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
lower level	145	31.9	31.9	31.9
Medium level	239	52.5	52.5	84.4
Higher level	59	13.0	13.0	97.4
Very worrying	12	2.6	2.6	100.0
Total	**455**	**100.0**	**100.0**	

Source: Field survey, 2021/22

As outlined in Table-9 above, the result indicate essentially that the extent of prevalence of litter and refuses / discarded COVID-19 related waste and its pilling up situation is observed and rated by the survey respondents as medium level as confirmed by a little higher than half of the respondents, 52.5% (n=239) during the pandemic. Contrary to this, about 31% (n=145)

respondents claimed the occurrence of littering situation as lower level and the remaining 13 % (n=59) identified as lower level.

The result obtained from the subsequent side line interviews held with KII and field /site observation in the different parts of the city reveled also that, due to the increasing use of face masks, disinfectants and PPE, there are in properly discarded litter items around public places and the environment which requires proper management due to the possibility of their potential contaminationincluding likelihood of secondary spread of the virus through municipal solid waste.

The results of a study done in Toronto, Canada, found that disposable gloves and face mask accounted for about 44% and 31% of debris related to personal protective equipment, which is known as a new source of plastic pollution (Ammendolia et al. 2021).Another Kenyan study illustrated that up to 16.5% of the total litter experienced in the streets is related to the COVID-19 items, while litter associated with COVID-19 was not found on recreational beaches (Okuku et al. 2021).

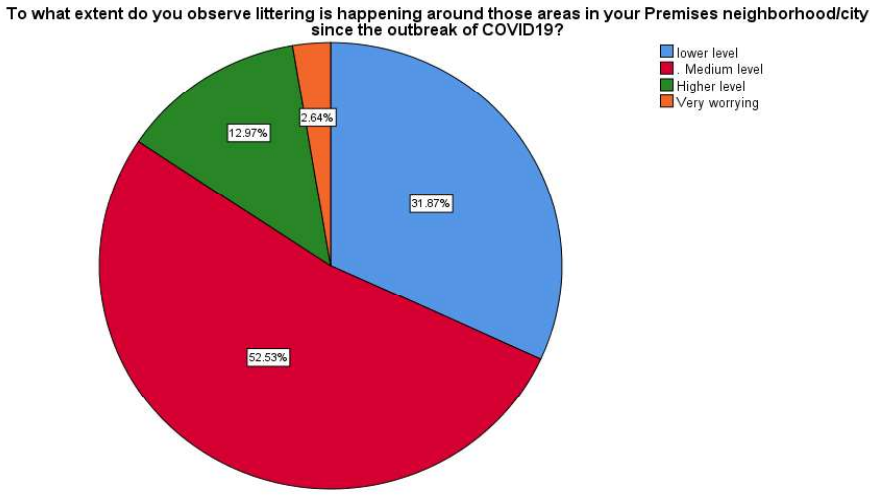

Table 10: Percentage of respondents agreeing on state of dropping of any post used PPE & packaging litters into the environment?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Yes	123	27.0	27.0	27.0
Sometimes	181	39.8	39.8	66.8
Never	151	33.2	33.2	100.0
Yes	123	27.0	27.0	27.0
Total	**455**	**100.0**	**100.0**	

Source: Field survey,2021/22

As depicted inTable-10 above, the result concerning on the state of appropriately discarding of litters such as face masks ,gloves, packaging and disinfectant bottles from among 455 survey respondents a fairly good proportion, 39.8% (n=181) considered and admitted sometimes in the dropping of any post used PPE litters inappropriately into the environment . As contrary to this 33.2% (n=151) indicate as never to have littered or discarded inappropriately post used PPE in to the environment/ground and about 27.0 % (n=123) admitted in the dropping of PPE litters inappropriately into the environment or ground. On the other hand in light of this,the KII

participants in explaining further who litters more and where littering occurs, the KII reported that although individuals in all age and sex category tend to litter, however ,slightly some participants explained that in terms of sex difference, men tend to litter more than women.

On the other hand, the data obtained from the field reconnaissance observation supported also the survey finding that individuals of any age and sex group did not keep their refusal properly and had been noticed in dropping of litters anywhere even in the presence of dustbins which may be related to inappropriate littering behavior of residents.

In light of this, studies /data conducted in the UK, USA, Australia and Canada in 2006 and 2008 on who litter and where much of the litter occurs including why this happens related to the difference in attitude have shown that men were more likely to drop litter more than women and that young people when in group under the age of 25 years were more likely to drop/do than the old people.Also, these literaturesidentified differences in attitudes towards littering by different groups in society.

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Table 11 : Insight of Respondents in to reason/ or driving force for the emergency/prevalence of litter and refuses during Covid1 9 time?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Complete absence of containers	73	16.0	16.0	16.0
Inadequate number of containers	145	31.9	31.9	47.9
Initial unawareness on the user side	69	15.2	15.2	63.1
Negligence	31	6.8	6.8	69.9
In efficiency in Municipal collection	10	2.2	2.2	72.1
In convince around containers	9	2.0	2.0	74.1
In efficient regulatory framework	27	5.9	5.9	80.0
COVID19DRIVEN SITUATION	3	.7	.7	80.7
All could be possible answers	88	19.3	19.3	100.0
Total	455	100.0	100.0	

Source: Field survey, 2021/2022

The result concerning the possible reasons for the presence of littering around their locality/neighborhoods and citywide are presented in Table-11 above. As outlined on the same table, the result indicate that a good proportion of the survey respondents, 31.9% (n=145) have reported inadequate number of dustbins/or waste collection containers availability as reason/driving force for littering that is followed by all of the factors mentioned as driving reason as rated by 19.3% (n=88) of the survey respondents.

The data obtained from the subsequent sideline interview secessions held and the walk through field observations rather suggest and reveals contrary situation in that individuals have been observed in discarding/littering of waste even in the presence of a litter bin under their nose. Again the various sidelines KII discussion result indicate as mentioned by most of participants, negligence of residents and inefficiency in the implementation and enforcement of existing SWM regulations including weak social norms in inhibiting littering behavior and nurturing compliance were mentioned as possible reason.

Even some informants indicated, that there are individuals in the society that tend to consider disposing of some type of litter as normal and acceptable. There are also some literature that substantiate this outlook that, when the prevailing social norm considered littering as normal and appropriate practice and the context , there is a growing tendency in the generation of more litter

dropped of wide spread .Also existing literature indicate that the availability of facilities, infrastructure including its distance and the location affect littering tendency .

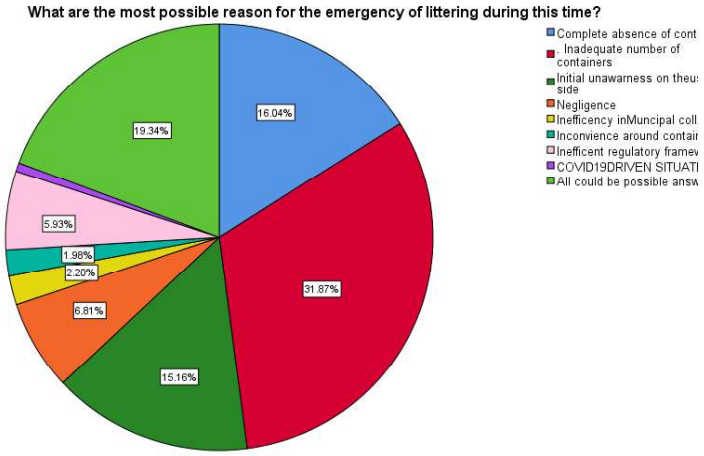


Table12 : Insight of respondents in to realizing the condition of littering extent and level in their premises/ neighbourhood/city during the COVID -19 pandemic time?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Yes	172	37.8	37.8	37.8
Sometimes	217	47.7	47.7	85.5
Never Know	64	14.1	14.1	99.6
Yes	1	.2	.2	99.8
	1	.2	.2	100.0
Total	455	100.0	100.0	

Source: Field survey, 2021/2022

The Table above indicates some results on question items included to evaluate the opinion of the survey respondents on the likely situation of extent and trend of littering city wide and around their premises. Comparing the results of the survey as indicated in the table above across it reveals that from among 455 respondents almost a little fewer/lower than half of the survey respondents, 47.7 % (n=217) rated 'somehow' in to realizing littering extent is increasing in the midst of COVID-19. In the survey result again about 37.8 % (n=172) rated or said 'yes' in realizing littering amount on the rise after COVID-19. While about 14.1% (n=64) rated/or considered never know about the situation.

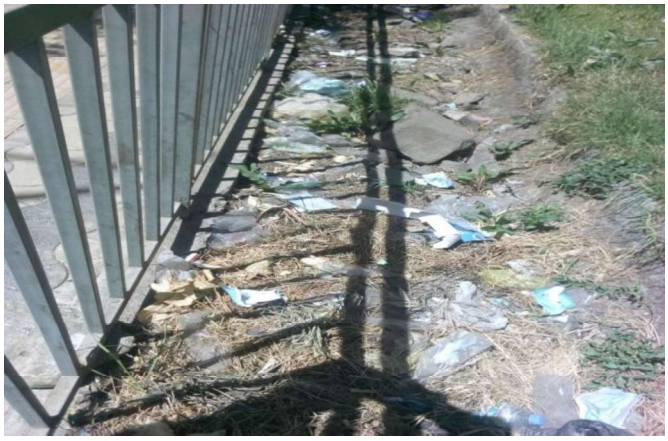
Table 13 : Insight of survey respondents on most known littered area where much of the littering is prevalent/happening?(multiple answers is possible)

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Around the street	238	52.3	52.3	52.3
Around Cafes/coffee houses, hotels restaurants	86	18.9	18.9	71.2
Around bus station	73	16.0	16.0	87.3
Around stadium	14	3.1	3.1	90.3
Around Public meeting halls/areas	43	9.5	9.5	99.8
other specify	1	.2	.2	100.0
Total	455	100.0	100.0	

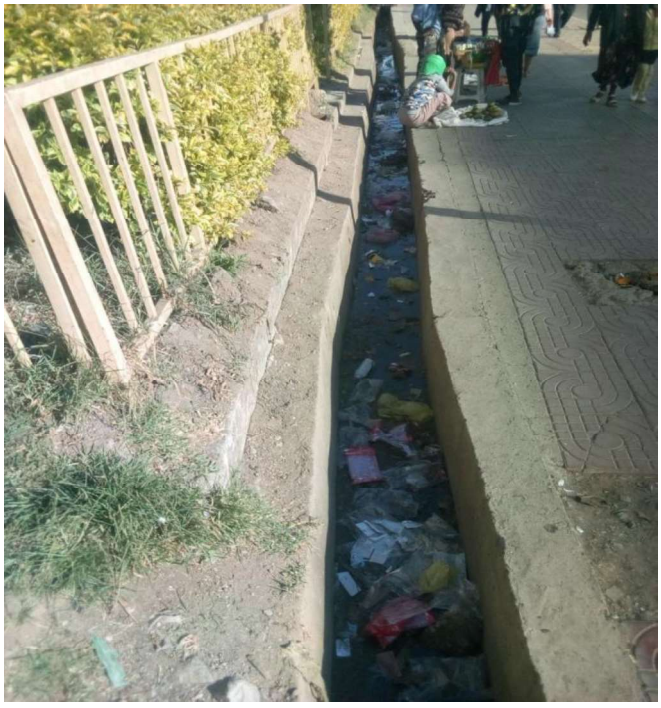
Source: Field survey, 2021/22

The result in Table-13above concerning where much of the littering of face masks and PPE is prevalent and abundant due to the persistence COVID-19 indicates that , discarded face masks and other litter items are known to have been found dropped on streets as overwhelming majority slightly higher than half, 52.3% (n=238) of the survey respondents identified and rated streets as most littered areas where much littering is prevalent. About 18.9% (n= 86) have also indicated cafes, coffee house and hotel and restaurant area as most littered areas. And this is followed by bus stations areas as most known littered part as identified by 16% (n=73) of the survey respondents where much of the littering is happening.

There are emerging literature/studies that have been conducted on the quantity and composition of litter that substantiate the present study result that much of the growing litters such as discarded face masks and gloves have been abundant in various public spaces such as around beaches, recreation areas during the pandemic ,which has increased during the time. For instance the conducted studies/literatures in the USA, Spain ,South America (Zambrano-Monserrate et al. 2020; Fadare and Okoffo 2020; Saadat et al. 2020; Ardusso et al. 2021; De-laTorre et al. 2021)) illustrated that the widespread use of masks and gloves play a crucial role in increasing litter in coastal areas.



Plates-1. Footage on unattended improper littering situation on open spaces, street/ditch line, around CMC &Megnagna areas



Plates-2.Footage on unattended improper littering situation on open spaces, street/ditch line, around CMC&Megnagna areas.

Table 14: Insight of Respondents agreeing on how they are cautious & concerned about littering while walking by and travelling?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Yes	343	75.4	75.4	75.4
Some how	88	19.3	19.3	94.7
No	24	5.3	5.3	100.0
Total	**455**	**100.0**	**100.0**	

Source: Field survey, 2021/22

As depicted in Table-14above,the overwhelming majority of survey respondents, 75% (n=343) claimed they are caution and extremely concerned in the dropping of litter while walking and travelling by without dropping. On the other hand referring the same table, fewer survey respondents, 5.27% (n=24) claimed that they are not cautious and concerned about the dropping of PPE post used litter while walking and traveling on land. Contrary to the survey result in reality based on systematic observation result from different site indicates that most pedestrians and travellers on land were caught and observed actually dropping of their post used litter items on the ground while traveling and walking as they wish which could suggest that there is a broader littering behaviour problem. On the contrary based on the subsequent side-line KII, most of the participants have stated that in principle by any means for whatever reason littering is unjustifiable and unacceptable.

Table 15: Percentages of Respondents agreeing onhow often do you litter into the environment/ ground?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Always	74	16.3	16.3	16.3
Some times	241	53.0	53.0	69.2
Never	140	30.8	30.8	100.0
Total	455	100.0	100.0	

Source: Field survey, 2021/22

Table – 15 above show the result on how often survey respondents do litter in to the ground in their daily life. Accordingly, the largest share of the respondents slightly higher than half, 53% (n=241) have rated sometimes and 30% (n=140) have identified never littered into the environment. On the other hand, 16.3% (n=74) rated always for they have been committing littering. Although the survey result have shown like this , contrary to this, the sideline walk through field observation and interview analysis results have shown different situation that people/residents practice litter dropping anywhere and at any time even in the presence of collection containers even under their nose

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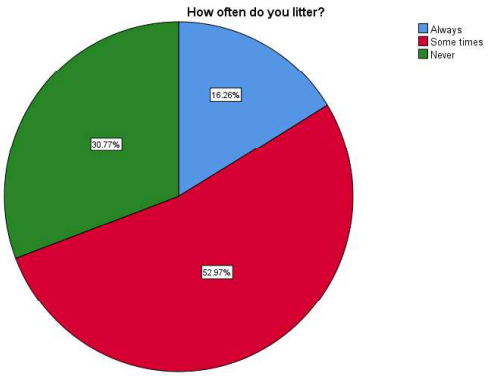
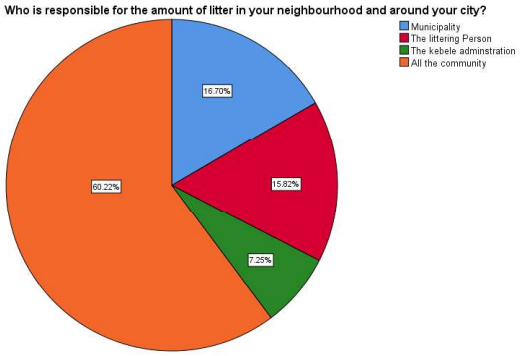


Table 16: Percentage of respondents agreeing on who is responsible for the amount of litter in their neighbourhood and around the city?

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Municipality	76	16.7	16.7	16.7
The littering Person	72	15.8	15.8	32.5
Thekebele administration	33	7.3	7.3	39.8
All the community	274	60.2	60.2	100.0
Total	455	100.0	100.0	
Total	455	100.0	100.0	

Table-16above shows the result on who is responsible for most of the littering problem in the study area. Based on the descriptive analysis result by using percentage from the total 455 survey respondents the largest share , 60.2 % (n=274) identified for all the community as responsible. About 16.7% and 15.8% claimed municipalities/local government bodies and the littering person respectively as accountable. In line with the subsequent side-line interview secessions most have also mentioned that littering is un-justifiable by any means.

On the other hand, the data obtained in the different subsequent side line interview secessions to identify the issue on who litter most , indicated that most of the participants have mentioned/or account the pedestrians and travellers on land and on vehicle in the study area as the main cause and largest source of litter and refuses. A study conducted in Australia in (2009) on sources and types of litter had also shown similar result that pedestrian and travellers land based litter accounted or identified for up to 87% of the general litter of the total types and number of litter.



Potential real challenges and magnitude of the problems of the challenges due to COVID-19 pandemic are presently felt with the SWM sector

The study has attempted to analyse the real challenges and magnitudes of the problems of COVID-19 challenges on the SWM by applying some families of descriptive statistics i.e. mean score to measure the variable, construct by designing a likert type questions(items) to measure the opinion of survey respondents .The effect of the independent variable with dimensions related to COVID -19 related waste were evaluated based on a 5-point Likert-scale ranging from '1' strongly disagree, '2' disagree,, '3' Neutral(N), '4' being Agree(A) and "5" "strongly agree".

Lastly, the overall result was computed and compared by calculating the average mean score based on mean score analysis given by Zaid Aton and Bagheri (2009).

According to the explanation of the promoters of the Likert-scale and mean score analysts explanation & interpretation, the mean score result below 3.39 is considered as low; themean score from 3.40 to 3.79 is considered as moderate and a mean score value of above 3.8 is considered as high

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Table17: Descriptive Analysis Result on overall challenges and magnitude of the problem COVID -19 challenges on SWM

S/n	Dimensions/ statements of attributes	N	Mean	St. Deviation	Per cent	Intensity/ degree
1	Is covid19 related waste a problem/ challenge for your setup/ neighbourhood and the city"	455	3.54	1.237	70	moderate
2	The safety of solid waste management workers and the livelihoods of those informal workers who depend on the SWM sector have been heavily affected& challenged by the lockdown due to COVID-19?	455	3.58	2.518	71.6	Low
3	Increased shift in the volume and quantity of solid waste production and redistribution has occurred in residential areas than industry& commercial centres due to COVID19 .	455	3.55	2.597	71	Low
4	The volume of medical waste has increased extensively unlike the ordinary time due to COVID -19 Pandemic related wastes.	455	3.28	.993	65.6	Low
5	Industrial and commercial waste production has fallen drastically due to the slowdown in manufacturing activity unlike the ordinary time due to COVID-19 pandemic driven impacts.	455	3.36	1.054	67.2	moderate
6	Driven byCOVID-19 pandemic hazardous waste production has grown with higher production from the pharmaceutical and medical sectors unlike the ordinary time.	455	3.16	1.022	63.2	low
7	Existing hazardous waste treatment capacity in the city is overwhelmed leading to storing/hoarding of waste and potentially inadequate disposal of this category of waste due to COVID 19 Pandemic.	455	3.15	.922	63	low
8	After COVID-19 outbreak, municipal waste has increased in volume that effectively overwhelming existing waste collection and disposal systems.	455	3.39	1.053	67.8	low
9	Changes in waste treatment activity has occurred as Government focus has been on the collection and transport of waste away from population centres.	455	3.53	1.075	70.6	moderate
10	Recycling of plastic and other products has slowed/decreased substantially, while the immediate driver for the slowdown is the perceived risk of COVID-19 transmission	455	3.24	1.047	64.8	low

11	After the outbreak of COVID-19, unlike the normal time, disposal at landfills has increased, in part, because more recyclable materials, such as plastics, are being sent to municipal waste channels .	455	3.53	2.193	70.6	moderate
12	The use of single-use plastics plastic-based personal protective equipment (PPE), such as gloves, masks, and disinfectant bottles, as well as packaging material has largely increased due to/driven by COVID -19 unlike the normal/ordinary time?	455	3.85	3.971	77	High
13	Increased generation of municipal waste due to COVID 19 related waste has made it financially and physically challenging for municipalities to cope	452	3.41	1.001	68.2	Moderate
14	Small and medium enterprises (SMEs) which are involved in waste collection and transport are being squeezed as most are unable to continue providing this critical service in the absence of continued payment.	455	3.37	.998	67.4	low
15	Due to COVID-19 most collected solid waste from the different premises of the city is currently transported to landfills or accumulates at temporary dumps unlike the normal/ordinary times?	455	3.42	.932	68.4	moderate
16	A reduction in recycling activities due to COVID-19 has further compounded challenges in the collection and disposal of municipal waste	455	3.41	.868	68.2	moderate
	Overall mean of COVID19 Impacts on SWM	**455**	**3.42**	**.981**	**68.46**	moderate

Source: Field survey, 2021/2022

Analysis result in Table -17above shows that, the overall challenges and magnitude of the problem of COVID-19 pandemic related challenges on SWM based on analysis of average mean score. Accordingly, based on the overall computed aggregate average mean score analysis result of the respondents' opinion as depicted above which is computed by taking the overall mean score analysis results of the statement of attributes indicates that, the challenges and magnitude of the problems of resulted due to COVID-19 pandemic on the SWM and on the overall aspects of the sector is a moderately significant as having an average mean score value of 3.42 or (68.46%).

Alongside with the survey analysis result, the different subsequent side- line interview secessions made with different key actors in SWM, have also confirmed that, shortly after or in the early active periods of the pandemic, there had been relatively more generation of single use waste materials generated from PPE waste used to protect the pandemic.

Table 18: Overall Result on Challenges and Impact of COVID-19 on the SWM

	No.of respondents	**Lowest**	**Highest**	**Average**	**St. Deviation**	**Percent %**
Overall Impact of COVID-19 on SWM	455	1	5	3.42	.979	68.46

Source: survey result, 2021/2022

Conclusions

This study aimed primarily in the examination of state of solid waste management challenges exacerbation due to littering in Addis Ababa city administration during COVID-19.The study explored the challenges and magnitude of the problem of COVID -19 challenges in those areas where the environmental impacts of the pandemic are most prominent, i.e. the solid waste management sector. A total of 455 survey questionnaires were distributed and collected with a response rate of almost 100%. from under 7 sub-cities some especially identified problematic public places which are known to have recurrent littering problems due to much people activity and high mobility and events. As with other cities of the world due to the fallout from the COVID-19 pandemic, the SWM sector in the study area suffered significantly and has felt substantial impact that was manifested in terms of improperly accumulated and collected waste, increase in the volume of single use disposable littered PPE waste, volume of waste dispose at landfill has increased, fall or reduction in reuse and recycling practice that was manifested at the early out break period of the crisis/pandemic. Based on the KII result, Small and micro enterprises involved in waste collection were challenged physically and financially as they were unable to collect SW as required to get fee or generate their revenues in return.

Likewise, another outstanding finding obtained from the present study as compared or contrary to other previous studies and parts of the world based on the qualitative data analysis, from the interview result is that, the generation of commercial, public areas and institutional areas waste production has increased as opposed to residential areas. However, at global context during the active pandemic period in most nations, the amount or volume of collected waste in residential areas had increased while in commercial areas there hadbeen decrease almost by half.According to a side-line key informant interview held with public-private partners/associations and micro and small enterprises representatives involved in Solid waste /SW collection and transportation activities, the impacts and challenges of COVID-19 had even been observed in temporal abandoning or quitting of their daily operation and service to zero level .Likewise, this has even challenged their business and firms sustenance resulting in overall income or revenue reduction and finance constrains as because they were not gaining payment from the collection and transportation services fees as there was lower supply of SW .

Also they had mentioned that as a result of this, they were forced to lay off some workers in their firms as there had no been active and longer works due to lower supply of SW from residential collection points .From further interview discussions report on the impact of COVID-19 on firms engaged in recycling operation, the vulnerability status was not different as they were challenged and affected to operate at full-scale capacity due to again short supply of recyclable materials where markets places of recyclables were closed.

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Authors' Contribution

The author has given final approval of the version to be published. Also the author has made contribution in the analysis and interpretation of the data manuscript to meet the expectations of readers

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Competing Interest

There is no conflict of interest so far in terms of the originality of the piece of knowledgeand nowherethe work has not beenunder review for publication.

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