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## NEW CHALLENGES FOR XXI CENTURY CITIES

Global warming, ageing of population, reduction of energy consumption,  
immigration flows, optimization of land use, technological innovation

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## Environmental factors affecting living comfort perception in different localities in Sri Lanka

Living comfort perception in urban and non-urban localities in Sri Lanka

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### Abstract

Living in comfort and the consequent healthier life is a reaction to the environment indicated by the absence of environmental stressors. The present study investigated the factors influencing the living comfort perception in an urban and a non-urban locality in Sri Lanka. A survey using a pre-tested questionnaire was carried out to solicit the people's perceptions on identified environmental factors randomly selecting fifty households from each locality. It was found that the factors i.e., water bodies, space, natural beauty, and biodiversity associated with the living comfort positively in the urban locality while the association was neutral in non-urban locality. The factors i.e., stray animals, dust and garbage negatively influenced living comfort in both urban and non-urban localities. The factors i.e., temperature, insects, flood, noise, smoke, vibration, and bad odor negatively influenced living comfort in the urban locality while the influence was neutral in non-urban locality. Further, the factors i.e., rainfall, wind, humidity and drinking water were not important for living comfort perception in both localities. The factors identified in this study are useful in zoning the localities according to their suitability in relation to public comfort perception. Further, the identified factors can be manipulated to improve the living comfort perception in urban and non-urban localities except for climatic factors.

### Keywords

Nature; Space; Shade; Garbage; Stray animals.

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## 1. Introduction

Quality of life is the degree to which a person enjoys the important possibilities of his/her life. Possibilities result from the opportunities and limitations each person has in his/her life and reflect the interaction of personal and environmental factors. Hence, the environment and its quality are one of the most important factors in determining the quality of life (Keles, 2012). However, the effective evaluation of environmental factors is a difficult task. The evaluation of environmental factors such as beauty, fresh air, noise, fumes, and congestion cannot be precisely determined because people themselves are not very specific about their likes and dislikes (O'Riordan, 1983). Low quality environment in recent years because of accelerated urban development, increased population density, industrial development led to the undesirable conditions in cities i.e. reduction of safety, vitality and liveliness. Stathopoulos et al. (2004) revealed that there is an integrated effect of environmental factors i.e. wind speed, air temperature, relative humidity and solar radiation on the human perception, preference and overall comfort in an urban environment. De Looze et al. (2003) have emphasized three elements in defining comfort across disciplines: 1- comfort is a construct of a subjectively defined personal nature; 2- it is affected by factors of a various nature (physical, physiological, psychological); and 3- it is a reaction to the environment. From the environmental ergonomics perspective, human comfort is evaluated by considering the interaction between the thermal, acoustic, vibration, lighting and air quality environment as these factors can affect performance, productivity, health and safety of people and has therefore influence over their behavioral response (Parsons, 2015). However, the intention to evaluate the environmental factors have been commonly concerned with human responses to cold and hot conditions, rather than assessing the environment as a whole (Parsons, 2015) and to further strengthen this point Ortiz et al. (2017) noted that absence of environmental stressors is important for human comfort feeling. When someone selects a place for living, the financial affordability plays a major role but the choice will be influenced by many other factors such as safety and environment of the locality, access to facilities, pollution of different nature etc. Further, when lands are sold for housing, usually better environments that could afford better living comfort due to its location will cost more since there is a trend towards seeking for a place with positive environmental factors. On the other hand, information on environmental factors that affect living comfort in a locality will also help zoning the locality according to its suitability. The living in comfort offers everything someone needs to have a healthier life, from the biological perspective it is a maintenance of homeostasis, which is a reaction to the environment indicating the absence of environmental stressors. Many studies by Mohamed Thariq et al. (2010), Reffat et al. (2000), Pinto et al. (2017) and Ghasemi et al. (2015) are reported on the indoor comfort, comfort in environment, seating comfort etc. Jansen (2020) concluded that preference for different type of residential environment and underlying motivations vary between households in urban and rural areas. According Bulygina et al. (2020), environmental comfort in the daily life of people living in rural areas and urban areas differ. However, underlying factors which affect the environmental comfort of residents were not thoroughly analysed. According to the literature available, no study is reported from Sri Lanka on the environmental factors affecting the living comfort in a locality. It is important to have an understanding about the living comfort of a locality and how and what the factors of the particular locality affect the living comfort of people. Hence, the present study was carried out with the objectives of identifying factors which influence the living comfort in two different selected localities (urban and rural), which in turn may help to have understandings to evaluate localities in relation to their living comfort.

## 2. Literature review

The need for comfortable living conditions in the country is a fundamental prerequisite for sustainable development thus supporting and improving the comfort of living environment, including the workplace, has recently become more important (Mishchuk & Grishnova, 2015). Webster's Dictionary defines comfort as a state or feeling of having relief, encouragement and enjoyment. Slater (1985) defines comfort as a pleasant

state of physiological, psychological and physical harmony between a human being and its environment. Richards (1980) stresses that comfort is a state of a person involving a sense of subjective well-being, in reaction to an environment or situation. According to Kolcaba (2003), comfort is “the immediate state of being strengthened by having the needs for relief, ease, and transcendence addressed in the four contexts of holistic human experience: physical, psychospiritual, sociocultural, and environmental”. The aforementioned literature indicates that in the human comfort perceptions is influenced by the living environment. Hence, what environmental factors or attributes influence living comfort need to be taken into account in improving living comfort in a locality. According to Pinto et al. (2017), comfort and well-being are commonly used interchangeably and both are presented as concepts related to quality of life. The quality of environment of a region or of a territory determines its conditions for the people to live in comfort which ensures the well-being and the health however, it is often bypassed in the in urban planning process and given a secondary status when compared to the disaster risk resilience which is a primary need (Margiotta et al., 2021). Environmental elements and their relationship to city are fundamental for the attainment of a high standard of urban life (Tulisi, 2017). The relationship between human needs and the city is reciprocal, as human needs must be fulfilled through all elements of the city to have a decent and comfortable life (Alsayed, 2024) which requires the identification of the environmental factors. According to Matsuoka and Kaplan (2008), the nature needs, directly linked with the physical features of the environmental setting, were categorized in terms of contact with nature, aesthetic preference, and recreation and play. The urban land management models are expected to deliver suitable habitat to maintain the biodiversity, let climate regulation while maintaining aesthetic, recreational and educational benefits in addition to enhancing the urban quality of life and social interaction (Pelorosso et al., 2013). According to Brunette and Vogher (2014), green infrastructures can assume a strategic role in restoring and enhancing the ecological and environmental services (Isola et al., 2023) and livability in urban areas. Stathopoulos et al. (2004) found that weather parameters such as wind speed, air temperature, relative humidity and solar radiation influenced the overall comfort in an urban environment. Peng & Timmermans (2019) found that the openness of public space had significant effect on user comfort. According to Zali et al. (2016), existence of open and green spaces is very important in new urbanism perspective, on one hand for providing beauty, balance and improvement of life quality and vividness of neighborhood and on the other hand, as places for gathering and creating social interactions. Manteghi et al. (2015) found that different kinds of water bodies have the capacity to cool the ambient temperature for the air thus contributes for environmental comfort. According to Sangkertadi & Syafriny (2016), optimum wind speed and shading devices for open space in urban area in humid tropical environment may contribute for outdoor thermal comfort. Klemm et al. (2015) found that street greenery will contribute to create thermally comfortable and attractive living environments. The environmental comfort in living is secondary when compared to the disaster risk resilience needs, which is primary, for a locality or for a town planning. However, once the basic needs are fulfilled, the next level needs arise and become important, thus the environmental comfort and its underlying factors becoming the important criteria to be fulfilled. Under this theoretical background, the present study evaluated the underlying environmental factors affecting the living comfort in different localities.

### 3. Materials and methods

#### 3.1 Site selection

Two Gramaniladari (GN) divisions (local administrative divisions) from Gampaha district in the Western province of Sri Lanka representing an urban and a non-urban area were selected in consultation with the divisional secretaries of Gampaha and Kelaniya. The GN divisions selected were Gangabada (an urban GN division from Kelaniya Divisional Secretariat Division - Fig.1A) and Keselwathugoda (a non-urban GN division



from Gampaha Divisional Secretariat Division - Fig.1B). The above urban and non-urban conditions were selected for the study in order to gather the people's perceptions on living comfort in their respective living environments and also considering factors such as easy access and safety of the data collectors when visiting households and the cost factors. Though the urban/rural binarism is widely to represent two opposite conditions, we for this study used the terms urban and non-urban to represent two opposite site conditions. Gangabada and Kehelwathugoda GN divisions are located within the Gampaha administrative district from the Western Province of Sri Lanka. The Gangabada GN division is located within the Kelaniya Divisional Secretariat division while Keselwathugoda GN division is located within the Gampaha Divisional Secretariat division. Gangabada GN division is 6 km from the Colombo city limits while Keselwathugoda GN division is 35 km away from Colombo city limits however this area is only 3 km away from Gampaha city limits. Gangabada GN division is located 20 km away from Gampaha city limits. These two locations are 24 km apart. With regard to the climatic conditions of Gampaha District, the minimum and maximum temperature is 21.6 °C and 37°C respectively. The average annual rainfall is 1,750 millimeters with hot wet zone climate. The rainfall is mainly during the periods of inter monsoon and southwest monsoon while during the period in January to April, dry climate exists all over the district (Gampaha District Secretariat, 2024). The population density of the Keselwathugoda and Gangabada GN divisions were 1,977/km<sup>2</sup> and 9,787/km<sup>2</sup> respectively. Tab.1 provides the characteristics on the land use in both study locations.

Land use	Gangabada GN division (Urban)	Keselwathugoda GN division (non-urban)
Built-up land	62.8%	48.2%
Vegetation	12.2%	46.9%
Bare land	2.7%	4.9%
Water bodies	22.3%	0.0%
Total	100%	100%

**Tab.1 Land use characteristics of the study areas**

### 3.2 Sampling and data collection

Samples were selected using the electoral lists of the respective GN divisions randomly based on random numbers generated by a computer. There were 777 families in Gampaha-Keselwathugoda GN division and 902 families in Peliyagoda-Gangabada GN division. Fifty households were selected from each GN division. Many variables were considered in the sampling. The age group selected was 25 - 55 years. The sample does not include children, elderly people and sick people because people's attitudes on environmental conditions may vary with age of a person and health conditions of the person. Both males and females were selected from both the sites. Perception of men and women may differ in their attitudes towards environmental factors that affect the living comfort. As environmental conditions vary with the time period of the day and as people may respond differently considering only the conditions at the time of surveying, data collection was done within the same time duration (9:00 am – 11:00 am) in several days. Preliminary data were collected through a questionnaire survey and site visits. For this purpose, fifteen households from each GN divisions were selected randomly and open questions were asked to collect preliminary data needed to design the questionnaire. The preliminary survey identified the factors temperature, rainfall, wind, humidity, water bodies, space, natural beauty, shade, biodiversity, stray animals, presence of insects, drinking water, flood, dust, noise pollution, vibration, garbage, smoke, odour and drainage as factors affecting or influencing living comfort in the study areas. Twenty environmental factors, which affect comfort in living in the study sites, were identified and these factors were included in the questionnaire, which was tested and refined employing a subsample. The improved questionnaire was used to collect data from the two study sites to solicit the people's perceptions on environmental factors, which affect their living comfort. The survey was conducted during weekends to



respondents were asked to indicate on each factor whether its influence on living comfort was positive or negative or neutral.

### 3.3 Data analysis

The rating given by each respondent for each factor was entered into the excel sheet directly from the questionnaire and imported to SPSS for analysis. For the analysis of data, chi square test and two sample t-test were used. The Chi square test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies. The expected frequency for each aspect considered was taken from the data collected during the preliminary survey. Using this test, the current situation in the study sites were compared with the expectation of the people. Two sample t-test was used to find out whether there is a significant difference between the two sites. To analyze the participant's response on positive, negative and neutral category, percentages were calculated for each category having the response given for each category and given in Tab.3.

## 4. Results and discussion

When the overall results are considered, according to the respondents' perception from urban Peliyagoda-Gangabada GN division (Tab.3), most of the factors caused discomfort perception for living conditions. In contrary to this, according to the people's perception from non-urban Gampaha-Keselwathugoda GN division (Tab.3), most of the factors caused comfort perception for living except few aspects. The results from both localities indicate that the same factors have different effects on living comfort perception for urban and non-urban settings. From the survey from both localities, it was observed that Peliyagoda-Gangabada GN division is an urban locality featuring almost all of the urban characteristics whereas Gampaha- Keselwathugoda GN division is a non-urban locality with rural settings. The findings, in overall, agree with previous findings where it was indicated that urban climate is hotter compared to the rural climate within the same region because of the development of thermal profile from asphalt (the dark covers of streets) and roofs, bricks and concrete (Oke, 1992; Arnfield, 2003; Santamouris et al., 2001). Further, heat output by industry, low evapotranspiration, motor vehicles and households, in addition to the low ventilation capacity of regions that have buildings, temperatures of an ambient air inside urban areas can be higher than similar rural areas (Margiotta et al., 2021) which forms an Urban Heat Island (UHI) under the specific conditions.

### 4.1 Effect of climatic factors on living comfort perception

When temperature is considered, the results of our study indicate that the temperature is not a significant factor associated with living comfort perception in non-urban locality (Tab.4) though it is a significant factor negatively associated with living comfort perception in urban locality (Tab.3 and Tab.4). The temperature effects in urban locality agree with previous findings that temperature is the main factor influencing the living environment (Echevarria Icaza et al., 2016) which may affect the comfort in urban locality due to the formation of UHI. The maximum temperature in addition to the other microclimatic factors have strong relationship with outdoor thermal comfort in urban areas (Yin et al., 2012). In overall, though the majority of the respondents identified temperature as a negative factor for living comfort perception, its association with living comfort in non-urban locality was not significant (Tab.4). Because we observed, during the survey, that the non-urban locality is sparsely populated with lot of greens and shades (Fig.1B) that developed favourable microclimatic conditions which might have neutralized the negative living comfort perception caused by temperature in the same locality. Further, it should be noted that 44% of respondents (Tab.3) identified temperature as a neutral factor for living comfort perception while none identified temperature as positive factor.

Factor	Positive (%)	Neutral (%)	Negative (%)
Temperature	-	44	56
Rainfall	-	65	35
Wind	8	88	4
Humidity	-	94	6
Water bodies	25	47	28
Land facilities	89	11	-
Natural beauty	98	2	-
Shade	97	3	-
Biodiversity	94	6	-
Stray Animals	-	7	93
Insects	-	6	94
Drinking water	54	35	11
Flood	-	6	94
Noise pollution	-	9	91
Dust	-	3	97
Smoke	-	1	99
Vibrations	-	1	99
Garbage	-	-	100
Bad odor	-	1	99
Drainage	100	-	-

**Tab.3 Positive, negative and neutral factors influencing living comfort**

Peliyagoda-Gangabada GN Division				Gampaha- Keselwathugoda GN Division		
Factor	$\chi^2$	Probability	Significance	$\chi^2$	Probability	Significance
Temperature	8.01	<0.01	**	2.11	>0.05	ns
Rainfall	2.15	>0.05	ns	2.24	>0.05	ns
Wind	2.33	>0.05	ns	1.55	>0.05	ns
Humidity	0.36	>0.05	ns	2.08	>0.05	ns
Water bodies	25.68	<0.001	***	2.06	>0.05	ns
Space	38.00	<0.001	***	2.28	>0.05	ns
Natural beauty	37.55	<0.001	***	2.26	>0.05	ns
Shade	39.50	<0.001	***	2.40	>0.05	ns
Biodiversity	39.50	<0.001	***	2.51	>0.05	ns
Stray Animals	34.32	<0.001	***	16.55	<0.001	***
Insects	24.41	<0.001	***	2.51	>0.05	ns
Drinking water	1.83	>0.05	ns	2.37	>0.05	ns
Flood	31.75	<0.001	***	2.13	>0.05	ns
Noise pollution	10.84	<0.001	***	2.18	>0.05	ns
Dust	13.02	<0.001	***	28.48	<0.001	***
Smoke	29.52	<0.001	***	2.69	>0.05	ns
Vibrations	32.73	<0.001	***	2.33	>0.05	ns
Garbage	19.58	<0.001	***	9.16	<0.001	***
Bad odor	9.52	<0.001	***	2	>0.05	ns
Drainage	39.03	<0.001	***	0.32	>0.05	ns

degrees of freedom = 4; \*\*\* - significant at 0.001 probability level; \*\* - significant at 0.01 probability level; ns - not significant at 0.05 probability level

**Tab.4 Chi square value for the factors of living comfort from Peliyagoda-Gangabada and Gampaha- Keselwathugoda GN Divisions**

Therefore, urban greening in addition to providing many ecological benefits, may function as neutralizer of temperature effects in urban localities (Isola et al., 2023). In the present study, we evaluated the overall living comfort perception (not only the thermal comfort) in urban and non-urban localities. There are other factors indicated by the higher percentage of respondents as affecting living comfort perception negatively than the temperature (Tab.3). The factors negatively affecting the living comfort perception are discussed in the following sections.

The results further indicate that factors i.e. rainfall, humidity and wind were not significant aspects associated with living comfort perception in both localities (Tab.4) studied and most of the respondents identified these as neutral factors (Tab.3). However, according to Ghasemi et al. (2015) the wind will have effects on comfort, safety, distribution of heat, dispersion of excessive humidity. Yin et al. (2012) found that the wind speed and relative humidity has strong relationship the thermal comfort in urban areas. The possible reason for obtaining the stated results in the present study could be that both localities in the present study fall under the low country wet zone climatic region in the same district in Sri Lanka where the climatic factors i.e., rainfall, humidity and wind are almost similar having the similar macro effects over the living environment with no significant effect on living comfort perception though these factors will have effects on thermal comfort. The present findings were supported further where 88% and 94% of the respondents indicated that wind and humidity were the neutral factors respectively in relation to living comfort perception (Tab.3). The present study provides the evidence based results on the association of the climatic factors on the living comfort perception of the respondents by comparing the urban and rural settings.

#### 4.2 Effect of water bodies on living comfort perception

The factor 'water bodies' effect was significantly associated with living comfort perception in the urban locality (Tab.3). The results of this study indicates that the water bodies in the urban settings can influence the living comfort and can contribute to improve the living comfort in the urban locality. Our findings agree with Manteghi et al. (2015) where they concluded water bodies have a positive effect upon microclimate of the surroundings with passive cooling effects for urban spaces and buildings. The availability of water resources makes it possible to create a comfortable living environment in the city and water bodies can create an atmosphere of unity and continuity in the urban fabric and make the city more attractive comfortable for living (Kurochkina, 2020). In contrary, respondents' living comfort perception in the non-urban locality was unaffected by the water body factor. This may be due to the favorable microclimatic effects already exists in the studied non-urban locality therefore the presence or absence of water body is not a significant factor for the living comfort in non-urban locality. The higher percentage of residents (47%) from both localities identified water body as a neutral factor (Tab.3), which is contradictory with regard to the findings (Tab.4) where water bodies significantly associated with living comfort in the urban locality. We, through our site visit, observed that water body in the urban locality was in a bad condition caused by water pollution, which could have been the reason for respondents to identify it as a neutral factor mainly in the urban locality. The environmental safety of water bodies is important for their ecological safety and their contribution to comfortable urban environment (Kurochkina, 2020). The findings in the present study may indicate that clean water body (unpolluted water body) in the urban locality may create a positive microclimatic environment for living comfort in the urban locality. The polluted water body may produce bad odor thus creating unfavorable conditions and negatively affecting the residents' perceptions and these type of water bodies may not provide the expected ecological services and emotional values. The areas close to water body in Gangabada GN division is affected by seasonal riverine flood may be another reason for the residents to perceive the water as neutral factor and also for more percentage of residents (28%) consider water body as a negative factor compared the residents who consider as positive factor (25%). The factor 'water bodies' effect was significantly associated with living comfort perception in the urban locality (Tab.3). The result of this study indicates that the water bodies in the

urban settings can influence the living comfort and can contribute to improve the living comfort in the urban locality. Our findings agree with Manteghi et al. (2015) where they concluded water bodies have a positive effect upon microclimate of the surroundings with passive cooling effects for urban spaces and buildings. The availability of water resources makes it possible to create a comfortable living environment in the city and water bodies can create an atmosphere of unity and continuity in the urban fabric and make the city more attractive comfortable for living (Kurochkina, 2020). In contrary, respondents' living comfort perception in the non-urban locality was unaffected by the water body factor. This may be due to the favorable microclimatic effects already exists in the studied non-urban locality therefore the presence or absence of water body is not a significant factor for the living comfort in non-urban locality. The higher percentage of residents (47%) from both localities identified water body as a neutral factor (Tab.3), which is contradictory with regard to the findings (Tab.4) where water bodies significantly associated with living comfort in the urban locality. We, through our site visit, observed that water body in the urban locality was in a bad condition caused by water pollution, which could have been the reason for respondents to identify it as a neutral factor mainly in the urban locality. The environmental safety of water bodies is important for their ecological safety and their contribution to comfortable urban environment (Kurochkina, 2020). The findings in the present study may indicate that clean water body (unpolluted water body) in the urban locality may create a positive microclimatic environment for living comfort in the urban locality. The polluted water body may produce bad odor thus creating unfavorable conditions and negatively affecting the residents' perceptions and these type of water bodies may not provide the expected ecological services and emotional values. The areas close to water body in Gangabada GN division is affected by seasonal riverine flood may be another reason for the residents to perceive the water as neutral factor and also for more percentage of residents (28%) consider water body as a negative factor compared the residents who consider as positive factor (25%).

#### 4.3 Effect of space on living comfort perception

Our study indicated that 'space' factor in the urban locality (Gangabada) is an important factor for the living comfort compared to the non-urban locality (Keselwathugod) (Tab.4). The space is required for the people to spend their leisure time, rest, and it is also important for the health and wellbeing of the people in urban settings. Most of the respondents (89%) identified space as a positive factor for living comfort, which indicates that it is comfortable to live in a locality where large open spaces are found. However, few respondents identified space as a neutral factor (Tab.3) which may indicate that few people are satisfied with limited space because it is difficult to maintain large space under urban conditions. In non-urban condition, living comfort perception was not associated with the space factor, the reason may be that the non-urban locality itself is spacious and not congested hence space factor is not a determinant of living comfort. Our findings are in agreeable with Chen and Ng (2012), where they stated that outdoor spaces are important and they contribute greatly to urban livability and vitality. The findings may indicate the need to have sufficient space in urban planning to improve the living comfort of an urban locality. The findings may indicate that the space is a more important factor than water bodies to the living comfort perception for urban locality.

#### 4.4 Effect of natural beauty on living comfort perception

The factor natural beauty is significantly associated with living comfort perception in urban locality (Tab.4). The results showed that natural beauty is an important factor for living comfort perception in urban locality compared to non-urban locality. However, identifying the natural beauty as positive factor by most of the respondents from both localities (Tab.1) may indicate that it is an influencing factor for the living comfort, thus the importance of having nature contact in the urban areas to improve the living comfort. Our finding is comparable with Cervinka et al. (2011) where they stated that psychological well-being, meaningfulness and vitality were found to be robustly correlated with contact with nature. According to Kabisch et al. (2022), a



misconception that cities as being artificial landscapes disconnected from nature exists. However, they argue that nature-based solution for urban localities can be integrated into urban areas through urban planning to improve the contact with nature in the cities. The green network (connections) or infrastructures (patterns) may be able to enhance quality of life with regard to the accessibility and human and environmental health (Tulisi, 2017). The natural beauty seems to equally important as space factor for living comfort perception mainly in the urban locality.

#### 4.5 Effect of shade on living comfort perception

The shade is a significant factor in affecting the living comfort in urban locality whereas it is not in non-urban locality (Tab.4) indicating the importance of shade for positive living comfort perception in urban locality. The non-urban locality what we studied is found with natural green shade hence the living comfort perception of respondents was unaffected by shade. However, most of the people (97%) in both localities (Tab.2) identified shade as an important positive factor for living comfort. This indicates that though shade did not have significant effect on living comfort in non-urban locality, it is important for positive perception of living comfort. The findings indicate that increase in the shade level in urban locality can improve the living comfort. Our study is in accordance with Klemm et al. (2015) in which they concluded that street greenery forms a convenient adaptive strategy to create thermally comfortable and attractive living environments. The findings indicate that the shade factor is equally important as space and natural beauty.

#### 4.6 Effect of insect factor on living comfort

The living comfort perception is negatively affected by insect factor in urban locality (Tab.4). Since the residents in the non-urban locality are normally exposed to insects, their perception is unaffected (Tab.4) by the insect factor which indicates that it is not an important factor for living comfort perception in such locality. However, the majority of the respondents (94%) identifying the insects as negative factor (Tab.3) for living comfort in both localities may indicate that the presence of insects is not favorable for living comfort perception. A study by Lemelin et al. (2016) found a mixed perception for the presence of insects, i.e., negative and positive depending on the species. The present study did not specify the insect's species rather considered the whole insect population. Hence, further investigations are needed to identify the effects of different insect species on the perception of respondents. The findings may indicate that the insect factor is one of the main contributors negatively affecting the living comfort perception in the urban localities. Here it is important to note that the green shade and green space which are highly associated positively with living comfort perceptions may attract the insects (a negative factor) into the urban areas. Therefore, the interaction effects need to be also addressed. Any future studies may take into account the interaction effects of main factors affecting living comfort perceptions.

#### 4.7 Effect of stray animals on living comfort perception

The "stray animals" is a significant factor associated with the living comfort perception in both localities (Tab.4). Further, most of the respondents (93%) identified the stray animals as a negative factor (Tab.3) for living comfort in both localities indicating that presence of stray animals is not a favorable factor for living comfort perception. This finding is supported by Karanikola et al. (2012), where in a study at a city park in Greece they found that a large percentage of the participants (67.8%) declare that they are bothered by the existence of stray animals in the public areas of the city. Further, they observed that the citizens who are bothered by the existence of stray animals regard the behaviour of these animals as hostile. The findings in the present study showed that the stray animal factor is as important as insect factor in contributing for negative living comfort perception in urban localities.

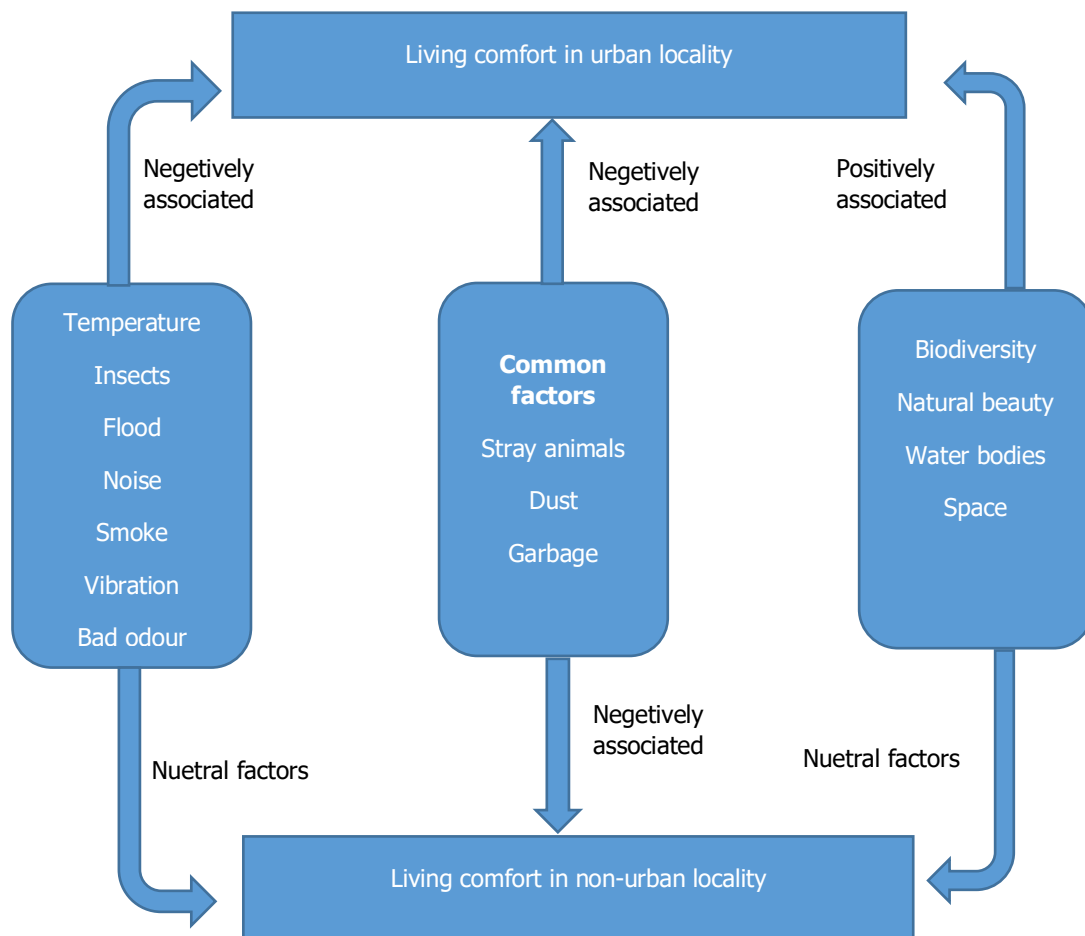
#### 4.8 Effect of noise and dust on living comfort perception

Though the noise factor associated with living comfort perception in urban locality (Tab.4) it was not associated with living comfort in non-urban locality. The reason may be that in general, the non-urban environment is less noisy further; the noise level may be acceptable for living comfort in non-urban locality. Having the results where most of the respondents identifying noise as a negative factor (Tab.3), it is concluded that the noise is not favorable for living comfort. Our finding is supported by Sheikh and Mitchell (2018) where they indicated that the quality of a "place" is highly influenced by our perception of sound in the surrounding environment. It therefore is important to maintain a noise level in the built environment that are perceived positively.

Our results (Tab.4) indicated that dusty air is a significant factor associated with living comfort perception in both localities. Further, most of the residents identified dust as a negative factor for living comfort (Tab.3). The findings of the study are in agreement with Nikolopoulou et al. (2009) where they suggested that as the concentration of particulate matter increases in the air (that means dusty level increase in the air) people perceive that the air is in poor quality, consequently the dusty air may be perceived by the residents as uncomfortable for living comfort. The respondents perceived both noise and dust are negative factors and contribute as equally as stray animals for living comfort perception.

#### 4.9 Effect of garbage and bad odor on living comfort perception

According to our results, garbage is a significant factor negatively associated with living comfort perception in both urban and non-urban localities (Tab.3 and Tab.4).



**Fig.2 Factors affecting living comfort perception in urban and non-urban localities**

The respondents perceived garbage as a common problem in their living environment and not favorable for improving their living comfort. Though the respondents perceived bad odour as not a problem affecting their living comfort perception in non-urban locality, it negatively affected living comfort perception in urban locality. In our opinion, the conditions for development of bad odour level is minimal in the non-urban locality and though bad odour is developed, diffusion takes place within a short period. This may be the reason for living comfort perception unaffected by bad odour in non-urban locality.

Fig.2 summarizes how factors identified associated with living comfort perception in urban and non-urban localities. The findings in the present study have wider implications for urban planning which need to integrates environmental comfort aspects affecting the living comfort perception of the residents.

Environmental comfort is of great significance on urban spatial planning and promotion of new urbanization and rural revitalization and also it can provide reference for planning and design in small and medium-sized cities (Liu et al., 2023).

## 5. Conclusion

The present study investigated factors which influence the living comfort perception in urban and non-urban localities in Sri Lanka. The study identified three group of factors i.e., positive factors, negative factors and neutral factors in relation to living comfort perception. Factors i.e., stray animals, dust and garbage were identified as common factors with negative association with living comfort in both urban and non-urban localities. These findings indicate the need for facilities in both urban and non-urban localities for waste collection and disposal which should be integrated at the urban and non-urban planning stage to improve living comfort, further, the need for management of stray animals and minimization of dust are significant for the comfort in the living environment.

It was found that the factors i.e., temperature, insects, flood, noise, smoke, vibration, and bad odor are important for urban localities since they have negative influence on living comfort and these findings provide importance insights for urban design and planning, on the other hand, these factors may not be important for living comfort in non-urban localities. However, the transformation of non-urban localities into urban localities is a continuous process happening through urbanization, the influences of these aforesaid factors need to be further investigated. The present study also found that the factors such as rainfall, wind, humidity and drinking water are not important for living comfort perception in both localities.

The factors such as water bodies, space, natural beauty, and biodiversity affects the living comfort perception positively in the urban localities but no positive or negative effects in non-urban localities. These findings indicate the need to integrate water bodies, space, natural beauty, and biodiversity into urban planning. In summary, the present study provides valuable insights about the factors that should be integrated and also the factors that should be eliminated or should be maintain at minimal level for the living comfort perception in an urban locality. Further, these factors will be useful in zoning the localities according to their suitability in relation to public perception. Despite the valuable insights, the study has some limitations. It was conducted in the Gampaha district in Sri Lanka.

The Gampaha district falls under low country wet zone according to the agro-ecological zones of Sri Lanka. The various agro-ecological zones may have varying level of influence on the living comfort perceptions due to the macro level climatic effects at urban and rural localities within the same zones. Therefore, it is necessary to test the conceptual model developed and presented in Fig.2 for various climatic zones and for different localities. Further, the presented study identified and investigated the effects of environmental factors on living comfort perception thus the study had the limited scope. Because, different factors identified may have varying level of effects on living comfort perceptions. Therefore, the comparative weightage of different factors and how it will influence the living comfort perceptions need to further investigated.

Finally, the identified factors can be manipulated to improve the living comfort perception in urban and non-urban localities except for the climatic factors.

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