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Development of a Scale to Analyse the Environmental Sustainability through Urban Gardens

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Abstract

Research was conducted to understand how gardeners perceive environmental sustainability for which there is a need to measure using a psycho metric scale. Though several scales available were intended to measure the other forms of sustainability *i.e.* economic, agriculture, social *etc.* whereas environmental sustainability per se was not available. So, the study was taken to develop a scale to measure environmental sustainability through urban nutri-gardens in Bangalore district. Likert summated scaling technique was employed. Based on operational definition of construct - environmental sustainability through urban nutri-gardens responses for 70 items belongs to 6 domains were obtained from 56 judges. Based on relevancy test, 59 items were retained. Responses for these 59 items were obtained from 32 urban gardeners of non-sample area. Criterion group performed to evaluate individual items and critical ratio was calculated using t-test. Forty eight statements with highest 't' values equal to or greater than 2.45 were selected and subjected to reliability in non-sample area consisting of 32 urban gardeners. Correlation coefficient was 0.9210 and 'r' value after adjusting for scale was 0.9592 which was significant at 1:00 per cent level indicating the high reliability of the instrument. Validity, which was found to be 0.974 for scale. Hence, the validity coefficient was also found to be appropriate and suitable for the tool developed. All the components considered were appropriate in measuring the environmental sustainability of the urban gardener's through urban gardens. Final scale composed of 48 statements. The developed scale was administered to 32 gardeners in the non-sample study area as a pilot study and it was found that 40.63 per cent of the gardeners had medium level of environmental sustainability. This specifically developed scale can be used to measure the gardener's environmental sustainability in study area as well as beyond the study area.

Keywords : Statements, Urban gardens, Environmental sustainability, Reliability, Validity

According to the United Nations prediction that by 2050 about 64 per cent of the developing countries and 86 per cent of the world will be urbanized. In India more than 30 per cent of the population lives in urban areas which is expected to grow further. Urban population growth in Karnataka, especially in Bengaluru is increasing at a faster pace. Bengaluru metropolitan region ranked 24th and 4th in the world and India, respectively. By 2030, it will be 12th most populous urban region in the world. Urbanization is an inevitable consequence of socio-economic development, but in many countries, it is proceeding at a faster rate that is outpacing the growth of services and employment. Increased urbanization along with exponential growth in population has led to contraction of cultivable farm areas and migration of rural population to urban areas in search of jobs. This increase in population has outstretched the problems of food and nutrition security. It is influencing all phases of food production and consumption. Urban poverty and food scarcity are increasing along with the unemployment rate, beside

air and water pollution most common in urban areas. The land available for agriculture is also getting reduced due to rapid conversion of land into housing, industrial development and highways will lead to the most important environmental challenge faced by human beings. (Suresh and Shivamurthy, 2017).

Urban agriculture contributes greatly to the food security of major cities across the globe. With increase in global population and reduced area under agriculture over years, urban farming is seen as a big solution to traditional agriculture. Urban as well as peri-urban agriculture can help in achieving nutritional security; though conventional agriculture needs to be continued, but urban agriculture can supplement traditional farming. One of the studies noted that one square meter of urban farming is capable of producing 36 heads of lettuce for every 60 days, 10 cabbages for every 90 days and 100 onions for every 120 days. Moreover, urban farming is capable of bolstering more social and political inclusion, sustainability in environment, economic progress and unified water and land policies (Cabannes, 2012 and Nugent, 2000). On the whole, urban farming is a novel initiative which has been encouraged across the urban areas so as to re-create clean, green and sustainable urban areas in the near future. According to FAO report, urban garden lands are 15 times more productive than rural holdings. Urban farming paves way to nutritional security of the population and ensures environmental sustainability.

Sustainable development is a development that meets the needs of the present without compromising the needs of future generations to meet their own needs (Brundtland, 1987). The principles of sustainability are the foundations for three pillars: the economy, society, and the environment. Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future (Grossarth and Hecht, 2007). It means committing to environmentally sustainable practices to build thriving communities and secure future growth potential. For continuous change in dynamics of urban-rural interface will increase pressure on environment for its resources, it will lead to exploitation of resources and increase pollution levels in globe, degradation of natural resources and change in land usage. As environmental sustainability is an ecological factor which can be measured in social science by development of statements or items which will access the way it brings the sustainability through urban nutri-gardens by the gardeners. Many of the earlier studies deliberated on scales constructed on overall sustainability, which inclusively economic sustainability and agricultural sustainability etc. these sustainability scales will measure all components of sustainability, such as economic, social and environmental, but there is no scale particularly related to environmental sustainability. Measuring environmental sustainability will helps in understanding the way in which planning the production systems and urbanisation of cities.

There is no scale to analyze the environmental sustainability of urban gardens, hence the present research study was taken up to develop and standardize a scale to analyze the environmental sustainability of urban gardens towards gardening.

Methodology

Study was conducted in Bengaluru as a greater number of people are interested in practicing urban farming as they are more concerned about their health. The intention of the study was to have a birds eye on the urban nutri-gardens effect on environmental sustainability. In the current study, a scale was instrumented to measure the environmental sustainability of urban gardens. Scale consisted six domains *viz.,* targeting renewable resources, conservation of ecosystem, pollution mitigation, health and welfare, intergenerational decisions and intrinsic rights. 110 items were framed after reviewing the related literature. Further, by following the 14 criteria enunciated by Edwards (1969), 70 items were drawn in line with label, abstract, construct and concept of the study. These items were subjected to relevancy test among ninty seven environmental, social, horticultural, food and nutritional scientists

working in State Agricultural Universities, Indian Council of Agricultural Research Institutes and Developmental Departments, to critically evaluate the relevancy of each items. As a result, 56 responses were received duly filled. The responses were obtained on five-point continuum from most relevant to not relevant further computed relevancy percentage, relevancy weightage and mean relevancy scores as given below.

Relevancy Percentage (RP) : Relevancy percentage was worked out by summing up the scores of Most Relevant (MR), Relevant (R), Somewhat Relevant (SWR), Less Relevant (LR) and Not Relevant (NR) categories, which were converted into percentage.

$$\text{R.P.} = \frac{\text{MR}\times5+\text{R}\times4+\text{SWR}\times3+\text{LR}\times2+\text{NR}\times1}{\text{Maximum possible score}} \text{ x } 100$$

Relevancy Weightage (RW) : It was obtained by using the following formula

$$\text{R.W.} = \frac{\text{MR}\times5 +\text{R}\times4 + \text{SWR}\times3 + \text{LR}\times2+\text{NR}\times1}{\text{Maximum possible score}}$$

Mean Relevancy Score (MRS) : It was worked out using the following formula

$$\text{M.R.S.} = \frac{\text{MR}\times5 +\text{R}\times4+ \text{SWR}\times3 +\text{LR}\times2+\text{NR}\times1}{\text{Number of judges/experts responded}}$$

Statements having relevancy percent more than 75 per cent and above, relevance weightage more than 0.75 and above and mean relevancy score more than 3.75 were considered for the final selection of statements. Out of 70 statements, 11 statements did not qualify and hence were deleted (Kumar and Popat, 2016; James and Lakshminarayan, 2017; Biradar, *et. al,* 2021; Jiragal and Ganesamoorthi, 2022). These 59 relevant statements were then subjected for item analysis by interviewing 32 gardeners from Chintamani town of non-study area through personal interview technique and responses were obtained on five point continuum. Than score of the respondents for obtained summing up the score of all 59 statements. 25 per cent of respondents with highest total score and 25 per cent of with lowest scores were selected. These 2 groups provided the criterion groups in terms of evaluating the individual statements as suggested by Edwards (1969). The critical ratio was calculated by t-test to differentiate the high group from the low group. The 't' value was calculated by using the formula suggested by Edwards.

$$t = \frac{XH - XL}{\sqrt{\frac{SH2}{nH}+\frac{SL2}{nL}}}$$

Where,

X_H = the mean score on given statement of the high group

X_L = the mean score on given statement of the low group

SH_2 = the variance of the distribution of responses of high group to the statement

SL_2 = the variance of the distribution of responses of low group to the statement

nH = Number of subjects in the high group

nL = Number of subjects in the low group

t = the extent to which a given statement differentiates between the high and low groups.

The selected items were then subjected for reliability testing using split half method. Scale was split into 2 halves on the basis of odd and even numbered items. These two forms were simultaneously administered to 32 gardeners of the study area. Chintamani town was selected and data were collected by personal interview technique. Collected responses were analysed using Karl Pearson's product moment correlation coefficient. To adjust the split half reliability in to the full test reliability Spearman-Brown prophecy formula was applied. Content validity of scale was established as selection of statements were made by seeking expert opinion. Construct validity was obtained by finding the correlation coefficient of sub domain score with the total score of the test.

Half test reliability formula

$$r_{1/2} = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2)(N\Sigma Y^2 - (\Sigma Y)^2)}}$$

Where,

ΣX = Sum of the scores of the odd number items

ΣY = Sum of the scores of the even number items

ΣX^2 = Sum of the squares of the odd number items

ΣY^2 = Sum of the squares of the even number items

Whole test reliability formula

$$r_{1/1} = \frac{2r1/2}{1 + r1/2}$$

Where,

$r_{1/2}$ = Half test reliability

The developed scale with 48 statements were administered to 90 respondents of Bengaluru district. The responses are obtained on 5 continuum *viz.,* strongly agree, agree, undecided, disagree and strongly disagree with scores of 5, 4, 3, 2 and 1, respectively. The environmental sustainability scores of each respondent was calculated by adding up the scores obtained on all the items. The environmental sustainability scores on the scale range from minimum of 48 to maximum of 240 based on their scores urban gardeners are divided into 5 categories likewise very high, high, medium, low and very low using the mean and standard deviation as a measure of check.

Results and Discussion

Relevancy Analysis

Statements having the Relevancy percentage more than 75 per cent, Relevancy weightage more than 0.75 and the Mean relevancy scores more than 3.75 were considered for the final selection of statements. Out of 70 statements, 11 statements-sß didn't qualify and hence these statements were deleted. So, total items considered for the next step were 59. Details of relevancy test was given in the Table 1.

Item Analysis

Results of the item analysis are presented in the Table 2. After computing 't' values for all the items, statements with highest 't' value equal to or greater than 2.45 were selected. This enabled to select the items to be retained in the scale based on the highest discriminating values, besides eliminating those with poor discriminating ability and questionable validity. These 11 statements were disqualified.

Reliability of the Scale

Retained 48 statements are given in Table 3. These statements when subjected to split-half reliability the value of correlation coefficient was 0.9210. The r value after adjusting using the Spearman-Brown prophency formula was 0.9592 which was significant at 1:00 percent level indicating the high reliability of the instrument. Therefore, the test is reliable to measure the environmental sustainability of the gardening (Ahmed, *et.al,* 2019)

Validity

It refers to how well a scale analyses what it is purported to measure. The data was subjected to statistical validity, which was found to be 0.974 for scale which is greater than the standard requirement of 0.700. Hence, the validity coefficient was also found to be appropriate and suitable for the tool developed. Thus, the developed scale to analyze the environmental sustainability through urban nutri-gardens was feasible and appropriate. Table 4. Depicted summary of items retained across the different domains in different stages of the scale construction. Items identified initially were 70 and after judge's responses 11 were deleted. After item analysis based on t-test 48 items were retained finally.

Scale Administration

It was found that 40.62 per cent of respondents belonged to medium, followed by 25.00 per cent very low, 18.75 per cent very high, 9.38 per cent high and 6.25 per cent very low environmental sustainability category. Ahmed, *et.al.,* (2019) reported that the adoption of organic farming, agro-ecosystems will retain its sustainability through the creation of a safe and diverse agro ecosystem that could meet the food requirements of the society in a sustainable way,

TABLE 1

Results of relevancy test of pooled items

	Statements	Relevancy Percentage	Relevancy weightage	Mean relevancy score
A.	*Targeting renewable resources*			
	Urban gardening enhances the efficiency of natural resources	85.17	0.85	4.26
	Growing Urban gardening will reduce the dependence on the use of power consuming devices for moderating the room temperature	83.10	0.83	4.16
	Urban gardens increases the utilisation of natural resources	84.83	0.85	4.24
	Urban gardens consume waste water for growing plants which reduces the dependence on fresh water	84.14	0.84	4.21
	Urban gardens reduce the no of visits to markets for purchases, so decrease fuel requirements and reduces carbon foot prints	84.14	0.84	4.21
	Urban gardening promotes water harvesting in the cities	85.17	0.85	4.26
	Bio fortification is possible through urban gardening	74.48	0.74	3.72
	Government policies which enable to afford renewable resources	74.48	0.74	3.72
	Cost is more in urban gardening while shifting toward non-renewable energy sources	78.97	0.79	3.95
	Usage of non-renewable energy sources in urban areas is inherently different from that of rural areas	80.69	0.81	4.03
	Proper utilisation of non-renewable energy resources in urban gardening is cost and time effective	82.76	0.83	4.14
	Urban gardening efficiently uses the natural resources which are otherwise considered as near waste	78.62	0.79	3.93
	Crops grown on the rooftops are efficiently absorb and use the sunlight for their metabolism	85.52	0.86	4.28
	Soil medium which normally acts as growth media can be replaced by any other alternative media in urban gardens thus saving top soil	84.14	0.84	4.21
B.	*Conservation of ecosystem*			
	Urban gardens contributes towards increase bio life of the earth	82.41	0.82	4.12
	Urban gardens contributes towards reducing global warming	86.90	0.87	4.34
	Urban gardening facilitates in creation of the favourable micro climate of surrounding locality	88.62	0.89	4.43
	Urban gardens minimise accumulation of heavy metals in the soil	80.69	0.81	4.03
	Urban gardens reduce the usage of non-renewable energy sources by decreasing use of agrochemicals	84.83	0.85	4.24
	Urban gardening contributes in mitigating the greenhouses effect and global warming through its ability to sequester carbon in the soil	81.72	0.82	4.09
	Urban gardening encourage birds and other natural predators to live happily on gardens which assists in natural pest control	81.38	0.81	4.07

Table 1 Continued

	Statements	Relevancy Percentage	Relevancy weightage	Mean relevancy score
	Urban gardening helps in producing food in the locality which intern minimises transportation related greenhouse gas emission (carbon foot prints)	86.21	0.86	4.31
	Urban gardens provide fresh and healthy food using less energy	84.14	0.84	4.21
	Urban gardens absorb the greenhouse gases to maximum extent.	79.66	0.80	3.98
	Urban farming and gardening act as a saviour of local flora and fauna thereby maintain local biodiversity	81.38	0.81	4.07
	Urban gardening is a tool to effectively convert food waste into a nutritive compost	87.24	0.87	4.36
	Urban gardening protects and recharges earth's resources like soil and ground water	81.72	0.82	4.09
C.	*Pollution mitigation*			
	Urban gardens reduces the pollution to greater extent when compared to conventional farming	74.14	0.74	3.71
	Use of pesticides and chemical spray on plants in urban garden contaminates the soil, water and surrounding environment	84.14	0.84	4.21
	Urban garden reduces he possibility of use of plastic bags to carry food items like vegetables and fruits	87.24	0.87	4.36
	Due to improvement in micro-climate, it reduces the dependence on air-conditioners thereby contributes for low CfC emission	85.17	0.85	4.26
	Green foliage cover on these gardens acts as a natural sink for common contaminants	82.07	0.82	4.10
	Plant photosynthesis minimises Co_{-2} emitted in urban area	83.45	0.83	4.17
	Urban gardening reduces the soil compaction and loosens soil structure	72.41	0.72	3.62
	Urban gardening increases the microbial activity in the soil	81.72	0.82	4.09
	Urban gardening helps in recycling waste water for irrigating urban gardens	84.14	0.84	4.21
	Some tree species will reduce the noise pollution by reducing frequency of sound waves	77.59	0.78	3.88
	Urban gardening destroys the soil structure in the garden area	63.79	0.64	3.19
	Urban gardening reduces the wind speed to some extent as natural barrier	74.83	0.75	3.74
	Urban gardening ultimately leads to chemical free environment	74.83	0.75	3.74
D.	*Health and Welfare*			
	Biodiversity in urban areas increases lifespan by producing healthy ecosystem such as clean air, water and soil	85.52	0.86	4.28
	Growing by themselves can also substantially helps to minimise food wastage	84.14	0.84	4.21
	Green cover in and around residential area helps in preventing runoff	82.76	0.83	4.14
	Urban gardening generates employment opportunities	81.38	0.81	4.07

Table 1 Continued

	Statements	Relevancy Percentage	Relevancy weightage	Mean relevancy score
	Urban gardening increases the nutritional diversity among households	85.17	0.85	4.26
	Day to day gardening activities helps in burning excess calories	84.48	0.84	4.22
	Urban gardening decreases excess waste of manpower at house hold level	82.41	0.82	4.12
	Urban gardening reduces the mental stress & provide some sort of relaxation	87.59	0.88	4.38
	Threatened and endangered bird species may find suitable habitat on these gardens	82.07	0.82	4.10
	Contribute forcommunity gardens by using wastage of urban gardens	83.10	0.83	4.16
E.	*Intergenerational decisions*			
	Urban gardens produce which is grown local has high perceived value and less likely to be sorted as trash	82.41	0.82	4.12
	Urban gardening helps the children learn about the gardening practices along with their parents	85.86	0.86	4.29
	By formation of groups/clusters, common space can be coverted into gardens	85.86	0.86	4.29
	Supply of produce from urban areas can stabilise prices and ensure year round supply	83.79	0.84	4.19
	Use of high-tech agricultural practices will conserve and save resources	82.41	0.82	4.12
	To mitigate the effect of climate change urban gardening is one of the alternative	83.45	0.83	4.17
	In long run it will reduce the amount spent on carbon credit	80.69	0.81	4.03
	Urban gardens can facilitate agritourism and recreation	83.45	0.83	4.17
	Urban gardens will reduce pressure on rural areas for meeting food demand	79.31	0.79	3.97
	Urban gardens don't get any long-term benefits	69.31	0.69	3.47
	Growing urban garden is a short term nutritional plan	74.48	0.74	3.72
	Sometimes harmful pesticides used in urban gardens have residual effects for decades	73.79	0.74	3.69
	Urban gardens increases the green space in cities.	87.93	0.88	4.40
F.	*Intrinsic rights*			
	Urban gardens creates micro- bio diversity for many living creatures such as insects and birds	84.83	0.85	4.24
	Apart from providing monitory benefits urban gardens also concerned with nutritional values	83.45	0.83	4.17
	Can reintroduce ayurvedic culture in urban areas	78.62	0.79	3.93
	Urban people get better insights about humans environment interactions	74.48	0.74	3.72
	Urban gardens conserve few natural enemies, which are useful for ecosystem	81.38	0.81	4.07
	Urban gardens create interest in people by realising the value of nutritional food	82.07	0.82	4.10
	Urban gardens improve access to fresh and green vegetables	85.17	0.85	4.26

TABLE 2
Paired two sample t-test of criterion groups

Statements	Paired two sample	Status
A. Targeting renewable resources		
Urban gardening enhances the efficiency of natural resources.	4.8990	Included
Growing Urban gardening will reduce the dependence on the use of power consuming devices for moderating the room temperature.	3.3141	Included
Urban gardens increases the utilisation of natural resources.	1.9467	Excluded
Urban gardens consume waste water for growing plants which reduces the dependence on fresh water.	3.2615	Included
Urban gardens reduce the no of visits to markets for purchases, so decrease fuel requirements and reduces carbon foot prints.	4.1312	Included
Urban gardening promotes water harvesting in the cities.	3.8490	Included
Cost is more in urban gardening while shifting toward non-renewable energy sources.	6.7937	Included
Usage of non-renewable energy sources in urban areas is inherently different from that of rural areas.	1.5240	Excluded
Proper utilisation of non-renewable energy resources in urban gardening is cost and time effective.	1.2940	Excluded
Urban gardening efficiently uses the natural resources which are otherwise considered as near waste.	4.4836	Included
Crops grown on the rooftops are efficiently absorb and use the sunlight for their metabolism.	4.0505	Included
Soil medium which normally acts as growth media can be replaced by any other alternative media in urban gardens thus saving top soil.	2.0835	Excluded
B. Conservation of ecosystem		
Urban gardens contributes towards increase bio life of the earth	8.8465	Included
Urban gardens contributes towards reducing global warming	4.1952	Included
Urban gardening facilitates in creation of the favourable micro climate of surrounding locality	5.3666	Included
Urban gardens minimise accumulation of heavy metals in the soil.	4.5383	Included
Urban gardens reduce the usage of non-renewable energy sources by decreasing use of agrochemicals	1.5523	Excluded
Urban gardening contributes in mitigating the greenhouses effect and global warming through its ability to sequester carbon in the soil.	8.0333	Included
Urban gardening encourage birds and other natural predators to live happily on gardens which assists in natural pest control.	4.0000	Included
Urban gardening helps in producing food in the locality which intern minimises transportation related greenhouse gas emission (carbon foot prints).	4.5883	Included
Urban gardens provide fresh and healthy food using less energy	4.1284	Included
Urban gardens absorb the greenhouse gases to maximum extent.	3.6600	Included

Table 2 Continued

Statements	Paired two sample	Status
Urban farming and gardening act as a saviour of local flora and fauna thereby maintain local biodiversity	4.6569	Included
Urban gardening is a tool to effectively convert food waste into a nutritive compost.	7.2296	Included
Urban gardening protects and recharges earth's resources like soil and ground water	8.8465	Included
C . Pollution mitigation		
Use of pesticides and chemical spray on plants in urban garden contaminates the soil, water and surrounding environment.	4.0762	Included
Urban garden reduces he possibility of use of plastic bags to carry food items like vegetables and fruits	3.3806	Included
Due to improvement in micro-climate, it reduces the dependence on air-conditioners thereby contributes for low CfC emission	5.7208	Included
Green foliage cover on these gardens acts as a natural sink for common contaminants.	1.6557	Excluded
Plant photosynthesis minimises Co_{-2} emitted in urban area.	0.9547	Excluded
Urban gardening increases the microbial activity in the soil.	3.0193	Included
Urban gardening helps in recycling waste water for irrigating urban gardens.	5.3079	Included
Some tree species will reduce the noise pollution by reducing frequency of sound waves.	4.6188	Included
D. Health and Welfare		
Biodiversity in urban areas increases lifespan by producing healthy ecosystem such as clean air, water and soil.	2.0966	Excluded
Growing by themselves can also substantially helps to minimise food wastage.	4.4921	Included
Green cover in and around residential area helps in preventing runoff.	4.1952	Included
Urban gardening generates employment opportunities.	5.9876	Included
Urban gardening increases the nutritional diversity among households.	1.6749	Excluded
Day to day gardening activities helps in burning excess calories.	4.0505	Included
Urban gardening decreases excess waste of manpower at house hold level.	3.6003	Included
Urban gardening reduces the mental stress and provide some sort of relaxation.	4.0000	Included
Threatened and endangered bird species may find suitable habitat on these gardens.	3.3356	Included
Contribute for community gardens by using wastage of urban gardens.	4.9820	Included
E. Intergenerational decisions		
Urban gardens produce which is grown local has high perceived value and less likely to be sorted as trash.	6.7330	Included
Urban gardening helps the children learn about the gardening practices along with their parents.	4.2426	Included
By formation of groups/clusters, common space can be converted into gardens.	7.4833	Included
Supply of produce from urban areas can stabilise prices and ensure year round supply.	3.6924	Included
Use of high-tech agricultural practices will conserve and save resources.	4.1312	Included
To mitigate the effect of climate change urban gardening is one of the alternative.	3.2026	Included
In long run it will reduce the amount spent on carbon credit.	3.0500	Included
Urban gardens can facilitate agritourism and recreation	4.3028	Included

Table 2 Continued

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Statements	Paired two sample	Status
Urban gardens will reduce pressure on rural areas for meeting food demand.	3.8490	Included
Urban gardens increases the green space in cities.	3.3466	Included
F. Intrinsic rights		
Urban gardens creates micro- bio diversity for many living creatures such as insects and birds.	6.0000	Included
A part from providing monitory benefits urban gardens also concerned with nutritional values.	2.5621	Included
Can reintroduce ayurvedic culture in urban areas.	3.1704	Included
Urban gardens conserve few natural enemies, which are useful for ecosystem.	1.4660	Excluded
Urban gardens create interest in people by realising the value of nutritional food.	1.5396	Excluded
Urban gardens improve access to fresh and green vegetables.	5.8384	Included

TABLE 3

Items retained in the final scale

Statements
A. *Targeting renewable resources*
Urban gardening enhances the efficiency of natural resources.
Growing Urban gardening will reduce the dependence on the use of power consuming devices for moderating the room temperature.
Urban gardens consume waste water for growing plants which reduces the dependence on fresh water.
Urban gardens reduce the no of visits to markets for purchases, so decrease fuel requirements and reduces carbon foot prints.
Urban gardening promotes water harvesting in the cities.
Cost is more in urban gardening while shifting toward non-renewable energy sources.
Urban gardening efficiently uses the natural resources which are otherwise considered as near waste.
Crops grown on the rooftops are efficiently absorb and use the sunlight for their metabolism.
B. *Conservation of ecosystem*
Urban gardens contributes towards increase bio life of the earth
Urban gardens contributes towards reducing global warming
Urban gardening facilitates in creation of the favourable micro climate of surrounding locality
Urban gardens minimise accumulation of heavy metals in the soil.

Table 3 Continued

Statements
Urban gardening contributes in mitigating the greenhouses effect and global warming through its ability to sequester carbon in the soil.
Urban gardening encourage birds and other natural predators to live happily on gardens which assists in natural pest control.
Urban gardening helps in producing food in the locality which intern minimises transportation related greenhouse gas emission (carbon foot prints).
Urban gardens provide fresh and healthy food using less energy
Urban gardens absorb the greenhouse gases to maximum extent.
Urban farming and gardening act as a saviour of local flora and fauna thereby maintain local biodiversity
Urban gardening is a tool to effectively convert food waste into a nutritive compost.
Urban gardening protects and recharges earth's resources like soil and ground water
C. *Pollution mitigation*
Use of pesticides and chemical spray on plants in urban garden contaminates the soil, water and surrounding environment.
Urban garden reduces he possibility of use of plastic bags to carry food items like vegetables and fruits
Due to improvement in micro-climate, it reduces the dependence on air-conditioners thereby contributes for low CfC emission
Urban gardening increases the microbial activity in the soil.
Urban gardening helps in recycling waste water for irrigating urban gardens.
Some tree species will reduce the noise pollution by reducing frequency of sound waves.
D. *Health and welfare*
Growing by themselves can also substantially helps to minimise food wastage.
Green cover in and around residential area helps in preventing runoff.
Urban gardening generates employment opportunities.
Day to day gardening activities helps in burning excess calories.
Urban gardening decreases excess waste of manpower at house hold level.
Urban gardening reduces the mental stress and provide some sort of relaxation.
Threatened and endangered bird species may find suitable habitat on these gardens.
Contribute for community gardens by using wastage of urban gardens.

Table 3 Continued

Statements
E. *Intergenerational decisions*
Urban gardens produce which is grown local has high perceived value and less likely to be sorted as trash.
Urban gardening helps the children learn about the gardening practices along with their parents.
By formation of groups/clusters, common space can be converted into gardens.
Supply of produce from urban areas can stabilise prices and ensure year round supply.
Use of high-tech agricultural practices will conserve and save resources.
To mitigate the effect of climate change urban gardening is one of the alternative.
In long run it will reduce the amount spent on carbon credit.
Urban gardens can facilitate agritourism and recreation
Urban gardens will reduce pressure on rural areas for meeting food demand.
Urban gardens increases the green space in cities.
F Intrinsic rights
Urban gardens creates micro- bio diversity for many living creatures such as insects and birds.
Apart from providing monitory benefits urban gardens also concerned with nutritional values.
Can reintroduce ayurvedic culture in urban areas.
Urban gardens improve access to fresh and green vegetables.

TABLE 4

Details of construction and standardization of perception scale.

Components/Domains	Total items	Items retains after relevancy test	Items retained after items analysis
Targeting renewable resources	14	12	8
Conservation of ecosystem	13	13	12
Pollution mitigation	13	8	6
Health and welfare	10	10	8
Intergenerational decisions	13	10	10
Intrinsic rights	7	6	4
Total	70	59	48

Table 3 Continued

TABLE 5
Results of the administered scale

Category	Respondent	
	Score range	Frequency (%)
Very Low environmental sustainability (<Mean –S.D.)	172.28	8 (25 %)
Low environmental sustainability (<Mean –0.425*S.D.)	172.28 to 186.35	2(6.25%)
Medium environmental sustainability (<Mean +0.425*S.D. to >Mean - 0.425*S.D.)	186.35 to 207.14	13 (40.62 %)
High environmental sustainability (>Mean + 0.425S.D.)	207.14 to 221.22	3(9.38)
Very High environmental sustainability (>Mean + S.D.)	221.22	6 (18.75)
Mean=196.75	S.D.= 24.47	

along with the conservation of its scare resources. The results of present study were in consonance with study of Kowsalya and Krishnamurthy, (2017).

The environmental sustainability scale developed is found to be reliable, valid and internally consistent, hence it can be used to analyze the environmental sustainability of urban gardens.

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