



# An Exploratory Research On The Awareness And Adoption Of Urban Roof Top Gardening By Select Respondents Of Guntur District

1. Dr.S.V.Ramana Prof & Principal, Hindu College of Management, Amaravathi Road, Guntur

2. Mrs.Ch.Vyshnavi, Assistant Prof Hindu College of Management Amaravathi Road, Guntur

## ABSTRACT;

The land has become an expensive unit in India due to its diversion following urbanization, industrialization etc. Further, migration and settlement of rural people in urban areas has been increasing at an alarming rate. It is estimated that, in India, 40.76% of the population is expected to reside in urban areas by 2030. Thus, it is going to increase pressure on natural resources and production volume in the rural areas due to increasing demand for food in urban areas. The cultivated land in urban areas is already limited. Rooftop gardens are an ideal way for an urban gardener to expand their space. Many of the urban homemakers create their own garden, either vegetable or ornamental or a combination of both on the rooftop due to lack of space around their houses. The study explores the rooftop garden trends and identifies the awareness and adoption on various areas of rooftop gardening. The objectives of the study includes finding out the type of rooftop garden, identifying various plants, both vegetable and ornamental, grown in the rooftop, to understand the type of fertilizers and pesticides used in the garden and to analyze the effectiveness is the irrigation and waste management practices of the rooftop garden. A sample of 75 respondents residing in Guntur city in select areas of Vidya Nagar, Lakshmi Puram, Brodiepet, SVN colony maintaining rooftop garden, has been selected for the study through purposive sampling technique.

**Key Words:** Urbanization, Industrialization, Natural Resources, Home makers, roof top gardening etc.,

## Introduction:

Rooftops are underutilized and rarely-considered urban spaces with great potential for terrace gardening. Rapid urbanization, industrialization, land ceiling, construction of buildings, wide roads, offices, markets have resulted in non-availability of land for kitchen gardening activities in big cities and towns. Metropolitan cities have driven out agriculture from their boundaries. Owing to changing climatic conditions, a lot of pesticides and chemicals used in cultivation of fruits and vegetables affect the health of human beings.

A rooftop garden is a garden, either vegetable or decorative on the terrace of a building. Rooftop gardens, also called living roofs or green roofs, have many benefits such as utilizing space productively, convert CO<sub>2</sub> emissions and produce oxygen thereby improving air quality index, reduces the heat of buildings and energy costs and add beauty to the cityscape. Majority of the rooftop gardens also provides recreational opportunities for the family members. On hot summer days, rooftop gardens may also keep buildings cooler than traditional roofs. It is essential for reducing the urban heat island effect, which causes cities to heat up more because of the abundance of concrete and lack of flora. Rooftop gardens serve as organic insulation, minimizing heat absorption and radiation, reducing energy use, and improving urban microclimates. Another benefit of green roofs is the potential to convert private, semi-public, or even entirely public recreation facilities onto roofs in high urban-density neighborhoods.

### Objectives of the Study:

1. To find out type of rooftop garden and to identify various plants grown in the rooftop
2. To understand the different methods of adopting roof top gardening.
3. To Know the awareness levels about urban roof gardening in select areas.
4. To analyse the adaptation levels, reasons and problems faced by the urban roof gardeners.
5. To offer pertinent suggestions and conclusions.

**Scope:** The purpose of this study is to give an insight into what motivates middle-class citizens to engage in gardening. The Indian middle classes are described as well educated with busy, stressful lives and with a high resource use due to consumption, however, also with increasing awareness and practices of pro-environmental behaviour. (Mathur 2010) Serious environmental problems have become obstacles to the development of the city, how to expand the green area, reduce the pollution of the environment to improve the urban ecological environment, promote the sustainable development of the city, has become a top priority in the construction of cities today.

### Review of Literature:

Rooftop gardens are an ideal way for an urban gardener to expand their space. Many of the urban homemakers create their own garden, either vegetable or ornamental or a combination of both on the rooftop due to lack of space around their houses. According to Van Cotthem (2005) rooftop spaces otherwise which remain unused is made use of in urban area for organic vegetable production and horticulture.

Rooftop garden systems have been in existence for centuries. Early Roman civilizations gave great value to gardens and greenery. This value increased as the urban population increased. Archaeologically, it is difficult to prove the existence of rooftop gardens in ancient times, but there are literary references to them. *Scriptores Historiae Augustae* by Seneca describes rooftop gardens on ancient roman buildings (Farrar, 1996). While, Jashemski (1993) reports finding houses in the southwestern and western part of Pompeii with impressive terrace and roof gardens for social status and insulation advantages.

Vikings used turf on the walls and roofs of their homes to protect against wind and rain (Donnelly, 1992). Contemporary architecture has incorporated green rooftop and vertical garden designs such as the Midway Gardens in Chicago, Mountain Equipment Co-op in Toronto, and the Boyne River Ecology Centre in Shelburne, Ontario. (Hoffman, 1995; Peck and Callaghan, 1999)

Recently, countries of Northern Europe, especially Germany, Switzerland, Austria, and Scandinavia, have adopted the concepts of rooftop garden systems. This renewed interest has been attributed to “rising concerns regarding the degraded quality of the urban environment and the rapid decline of green space in intensely developed areas” (Peck and Callaghan, 1999).

State legislation and municipal government grants in Germany catapulted the rooftop garden markets since the 1980s to produce ten million square meters of ‘greened’ roofs by 1996 (Boivin, 1992). For many European municipal governments, a key motivator in green roof initiatives has been the improved storm water quality and quantity management. A municipal by-law was passed in Stuttgart, Germany, requiring that all flat-roofed industrial buildings have a grass roof (Johnston and Newton, 1996, p.48). Peck and Callaghan (1999) believe a new industry has been created for plants and material suppliers, roofing professional, etc. as a direct result of government policy and programs in Europe.

New interests are developing in North America from commercial industries like Mountain Equipment Co-op, Non-Governmental Organizations (NGO) to the Good Food Box. Chicago’s 12-storey city hall building will have a 21 000 square foot garden by the fall. The topographical features of the roof are being incorporated into the garden with more than 20 000 herbaceous plants, vines, and green grass and a crab apple and hawthorn tree. (Huang, 2000)

## METHODOLOGY

The study ‘Rooftop Gardening – An Explorative Study in Urban Area of Guntur City’ explores the rooftop garden trends, identifies its strength and weakness rooftop gardening through a household survey among urban homemakers. The study includes a baseline survey to explore the current trends of rooftop gardening, to find out type of rooftop garden, type of plants grown, how effective the irrigation practices, type of fertilizers used is, type of pesticides used, waste management practices, etc. A survey is a ‘fact finding’ study, a method of research involving collection of data directly from a population or a sample thereof a particular time. It is a field study which can be extensive or intensive, seeking responses directly from the respondents, covering a very large population and covers a definite geographical area. The baseline survey comprises selection of area, sample and tool.

**A. Selection of Area** The selection of relevant area is an inevitable part of the study. The area selected for the study is select areas of Vidya Nagar, Lakshmi Puram, Brodiepet, SVN colony in Guntur City. Guntur is the most upcoming city in Andhra Pradesh progressing on all levels with a large number of houses with minimum outside area. Due to urbanization people possess very little area around the house with no space for gardening. Thus, prefers rooftop gardening.

**B. Selection of Sample** A sample of 75 respondents residing in Guntur city maintaining rooftop garden has been selected for the study.

### C. Selection of Tool

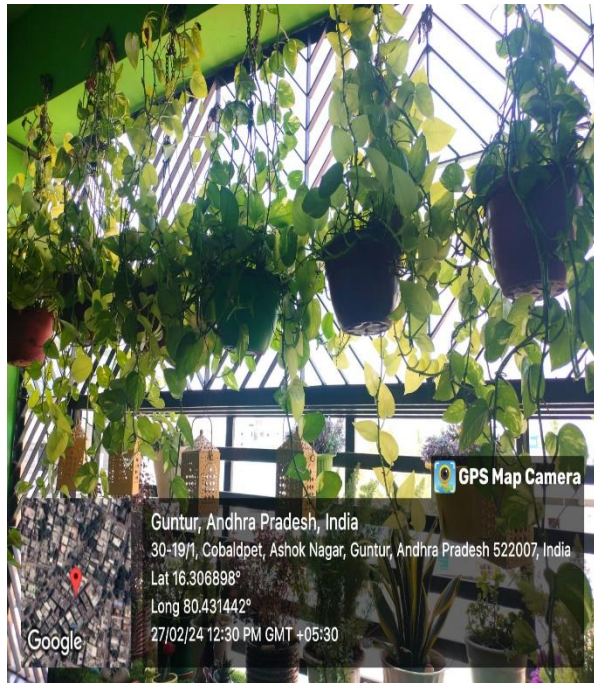
The selection of an appropriate tool is the most important task of a research study. An interview schedule will be formulated for collecting information regarding rooftop gardening. An interview schedule is a written list of questions, open ended or close ended prepared for the use of an interview in a person- to -person interaction. One of the main advantages of structured interview is that it provides uniform information, which assures the comparability of data.

### D. Collection & Analysis of the Data:

With the help of the structured questionnaire, the investigator collected the data through online from the respondents. The data gathered is consolidated, classified, tabulated and analyzed.

E. Purposive sampling technique is used for the selection of the sample. In purposive sampling, the researcher handpicks the cases to be included in the sample on the basis of their judgment of their typicality or possession of particular characteristics being sought.

**Images of Ornamental Plants – A Type of Roof Top Gardening:**



**Survey with one of the Respondents in Brodiepet Locality by the Team:**



**Types of Roof Gardening:**

Based on the amount of maintenance required, the depth of soil and the types of plants the area will support, roof gardens are classified into three basic types namely, extensive living roofs, semi-extensive living roofs and Intensive living roofs. Extensive living roofs range from as little as 2.5 to 12.5 cm in soil depth. Semi-extensive living roofs have deeper soils and can therefore support a greater number and wider variety of plants, making them more decorative. However, their depth makes them heavy so they require a strong structure to support them. They can combine the relatively low maintenance of extensive roofs with a more

aesthetic appearance. Intensive living roofs require a minimum of one foot of soil depth to create a more traditional roof garden, with large trees shrubs and other manicured landscapes. They require intensive maintenance. Besides the above three types, other types of roof garden as detailed below are also being designed in recent days.

**Container gardening:** Container gardening is a less expensive and highly flexible form of gardening that is especially effective for urban settings with little or no changes to the existing roof structure. Container gardening involves placing containers on a rooftop and filling them with soil and plants. It helps to avoid problematic soil by taking soil from area with healthy soil which can be further supplemented with compost produced from the garden's organic wastes as well as additional organic wastes produced within the building. Containers can be built from a variety of materials ranging from plastic drum, buckets, earthen pots, cement bags, storage container, wooden boxes that are readily available in household. Container gardening is particularly useful for people who lack the means or the will to make changes to the actual structure of the roof. Containers also have the advantage of providing depth and space for soil and roots, which is difficult to obtain with extensive green roof systems.

**Green roof system:** The second sort of roof garden, in which the rooftop is used as the planting medium, requires more investment but has its own set of benefits, such as better storm-water retention and building insulation. Specially designed layers separate the garden from the hard roof, provide drainage, supply nutrients, and even add contours. This type of rooftop garden is referred as a green roof system. There are two types of green roof systems extensive and intensive. An extensive green roof weighs lesser than an intensive green roof. It generally has shallower growing material and heartier plants that require little maintenance. Intensive green roofs are most like gardens on the ground—with deeper growing material, more intricate plantings, and more maintenance needs such as irrigation and pruning. Green roofs are constructed using a special base layer comprising root and water-proof membrane followed by a root barrier, water retention, drainage layer and lastly soil layer for growing plants. Usually, shallow rooted vegetables are grown in roof gardens and seedlings are removed after maturity periodically for roof garden maintenance.

**Rooftop hydroponics:** In the third rooftop garden possibility, plants are grown on a soilless media. Hydroponics is a means of growing plants with a substrate other than soil which may include peat, sand, Rockwool, coconut coir, perlite or vermiculite. A nutrient solution is used to water the plants. Rooftop hydroponics is the lightest of the three choices, and it may allow for faster plant development and higher yield. There are two basic hydroponic systems: a non-recycled nutrient solution, where the nutrient solution is only used once; and a recycled nutrient system. There are also many variations within these two systems and various models and designs are available for use. There are six main types of hydroponic systems to consider for the garden—wick hydroponic system, deep water culture (DWC), nutrient film technique (NFT), ebb and flow, aeroponics, and drip systems.

**Wick hydroponic system:** It is the simplest type of hydroponic system used to grow plants. It is easy to maintain and does not require aerators, pumps, or electricity. The plants are placed directly within an absorbent substance like perlite or vermiculite covered with nylon wicks into the nutrient solution. y Nutrient film technique (NFT): In this system, the nutrient solution is pumped into channels that hold plants. The channels are slightly sloped, so the nutrient solution flows through the channel, over the plant's roots and back into the hydroponic reservoir. NFT hydroponic system works best for plants that have a small root system, like leafy vegetables.

**Deep water culture (DWC) system:** Plants are placed in a net pot and are held by a floating platform above a container of nutrient and water. Plant roots are suspended and stretched into the nutrient-rich oxygenated solution. DWC is comparatively low cost, easy to build and water saving active recovery system. It just requires a net pot, a reservoir/container, a lid, and a pump.

**Ebb and flow hydroponic systems:** It is also called flood and drain system where plants are placed in large grow beds filled with growing medium. The bed is flooded with nutrient solution until it reaches a certain point. Water pump after running for a predetermined amount of time, shuts off draining the grow bed completely. Nutrient solutions are flooded onto the plant root system and then drain periodically in cyclic manner.

**Aeroponics:** Plant roots are suspended in the air and are misted with the nutrient solution continuously. The misting interval is fairly short, done by a pump controlled by a timer. Aeroponics system is expensive, and requires regular maintenance as nozzles sparing nutrient mist get choked.

**A drip system** is an easy-to-use hydroponic system that can be quickly altered for different types of plants, which makes this a great system for any grower who plans to make regular changes. Drip system pumps the nutrient solution through the tube and drops onto plant roots via a network of drip lines. At the end of each tube is a drip emitter that controls the amount of nutrient solution provided to plants as per the need of individual plant.

**Plants for roof gardening:**

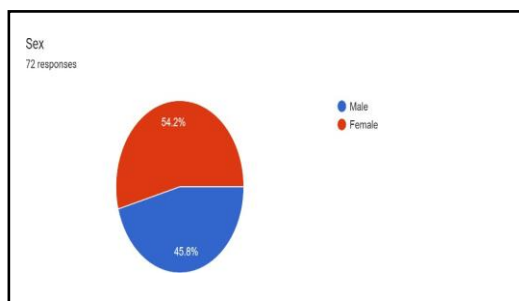
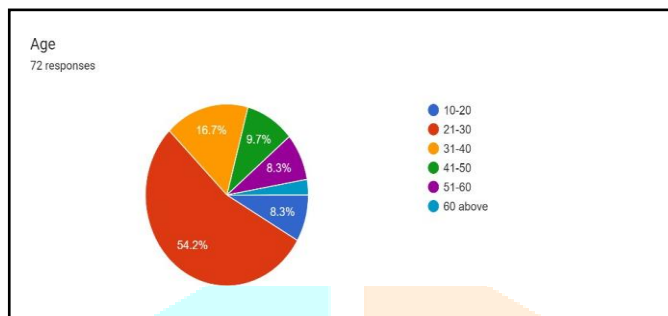
| Type of the plant     | Roof Gardening  |
|-----------------------|---|
| Climbers              | Ficus repens, Vernonia elaeagnifolia, Thurnbergia alata   |
| Flowering annuals     | Antirrhinum, Stocks, dwarf sweet peas, pansy, dahila, chrysanthemum, marigold, sweet alyssum, phlox, verbena        |
| Herbaceous perennials | Pelargonium, canna, Portilaca. Golden rod, Periwinkle   |
| Trees                 | Plumeriasp., Callistemon lanceolatus, Gliricidia maculate, Araucaria cookie, Mimusops elengi, Brassica actinophylla |

**Findings of the Study:**

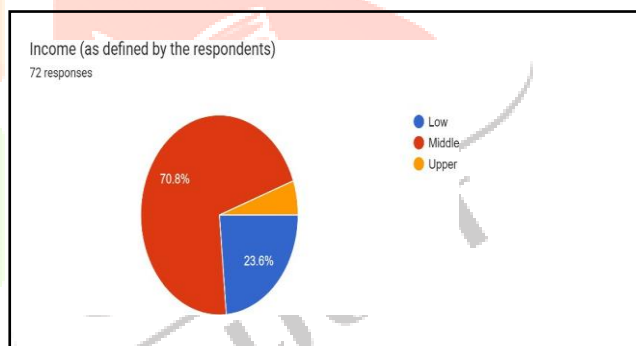
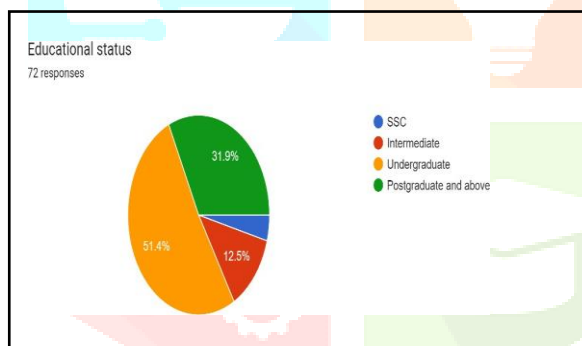
Today, especially in this mosaic concrete jungle, it is very important to retain our health by having pesticide free food. Moreover, moving towards self-sufficiency, rooftop gardens set an excellent example among urban community, for those who have less space around the house. When people are staying inside their house during lockdown period, gardening is considered as the best hobby that relieves everyone from stress, gives better experience with fresh air and provides satisfaction to inmates. Rooftop gardening, whether it is ornamental plant or organic farming, is a blessing for those who have no enough space for gardening, especially in urban areas. The new observations pertaining to the study on ‘Rooftop Gardening – An Explorative Study in Urban Area of Guntur City’ is discussed under the following headings.

1. Out of the total respondents majority of the respondents belong to the age group of 21-30 years particularly female 54.2% with a family size of 1-4 members, showed more interest to start roof top gardening. It shows about the increased awareness of the youth about health and wealth.

2. In the study area 51.4% of the respondents belong to undergraduates 70.8% belong to Middle class income people.

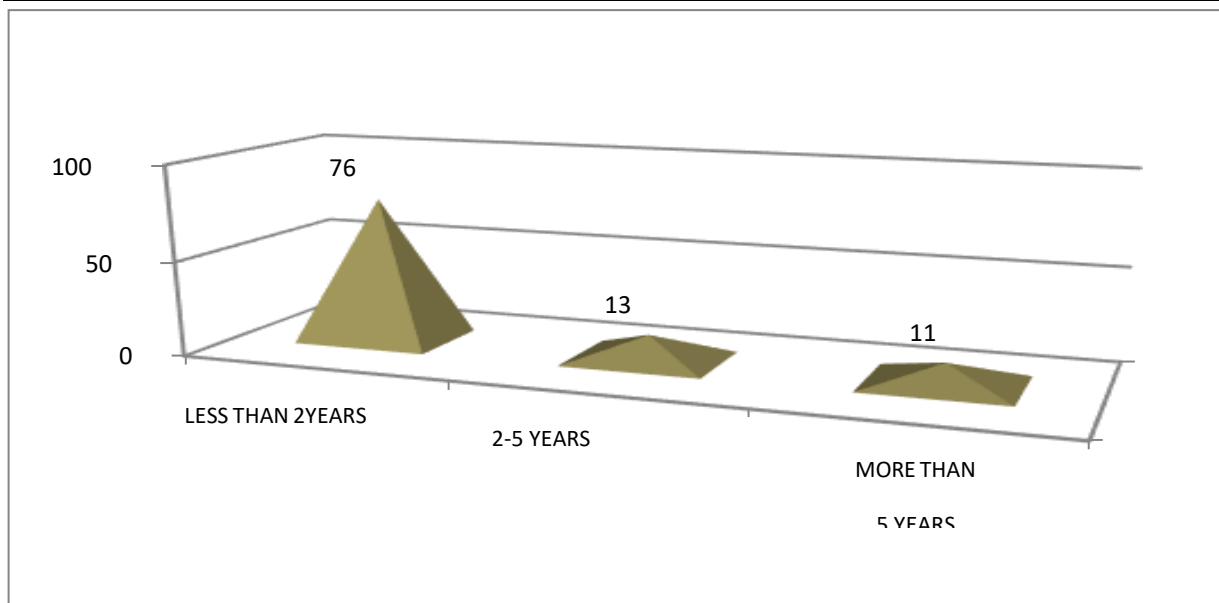


### . Period of Implementation of

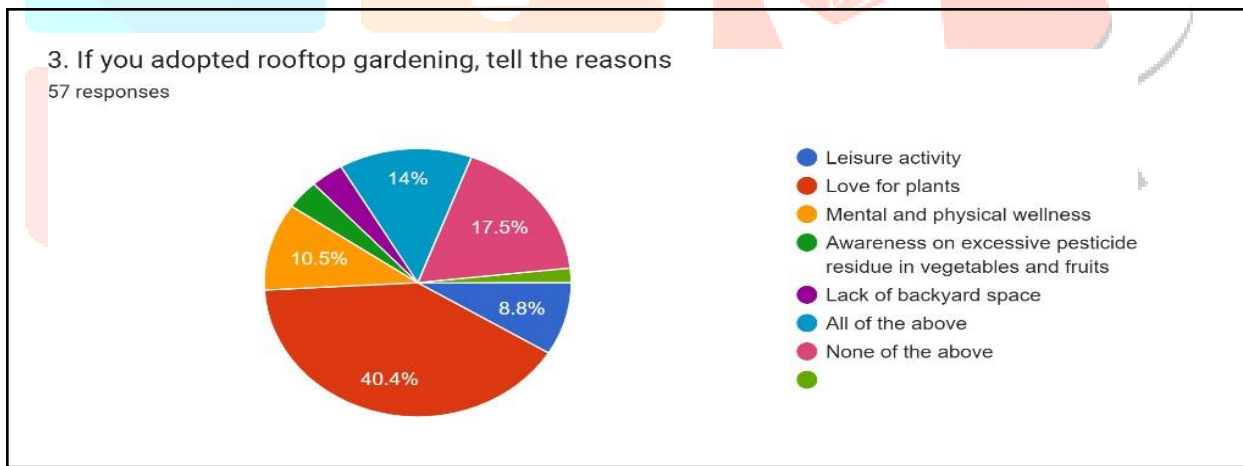
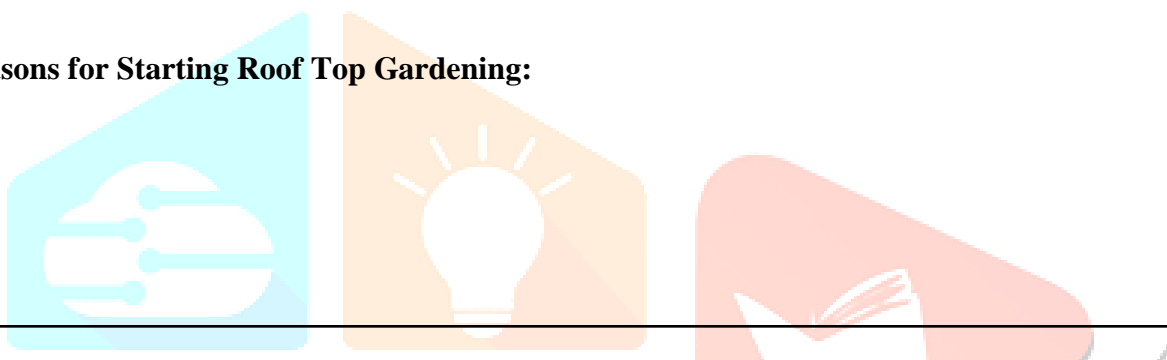


### 3. Period of Implementation of Rooftop Garden:

Majority (76%) the sample started doing rooftop gardening in less than 2 years. Other 13% were doing between 2 to 5 years and only 11% of them had a rooftop garden history of more than 5 years.

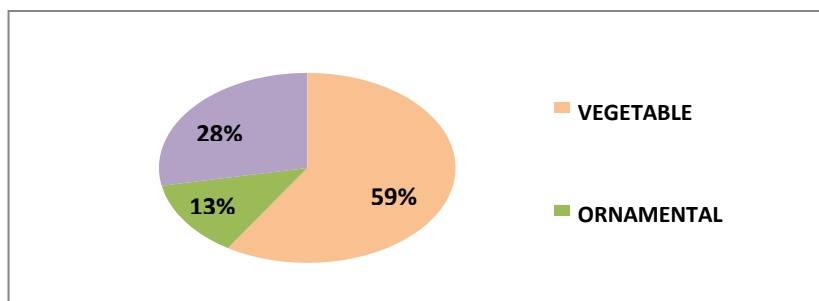


#### 4. Reasons for Starting Roof Top Gardening:



Majority of the respondents started doing roof top gardening to improve their health, 40.4% of family conscious about their health, 14% started as a hobby, 16% of them wanted to get rid of pesticides and 14% wanted to become self-sufficient.

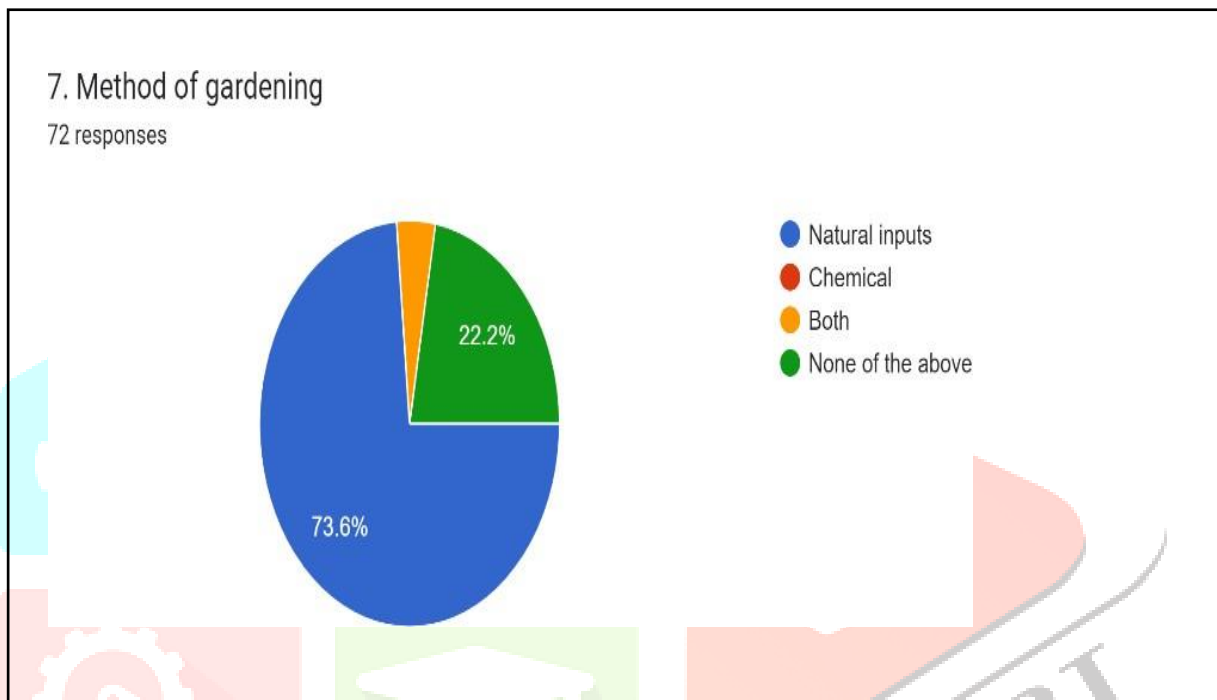
#### 5. Types of garden





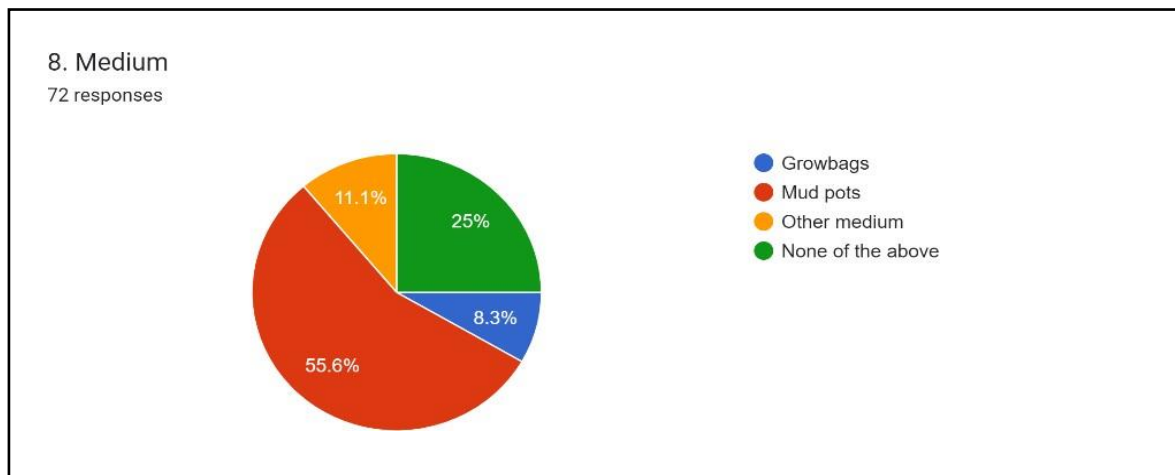
The study reveals that 59% of the sample were doing vegetable gardening, 28% combined garden - combined garden -vegetable and ornamental and 13% doing ornamental plants only.

### 6. Method of Gardening:



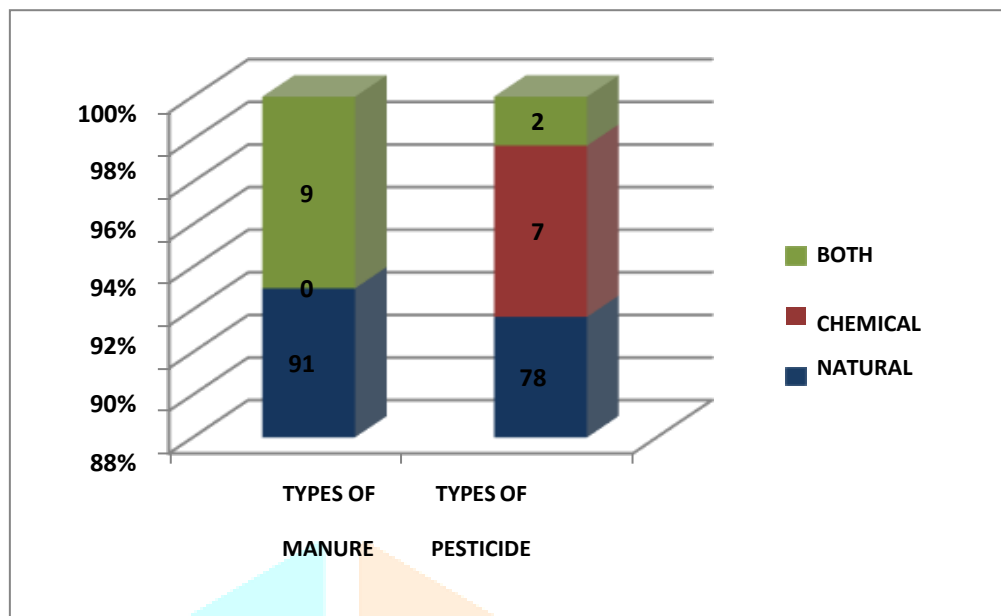
The study reveals that 73.6% are using natural inputs for gardening, and 22.2% are using chemicals and 4.2% are using both .

### 7. Type of Gardening:



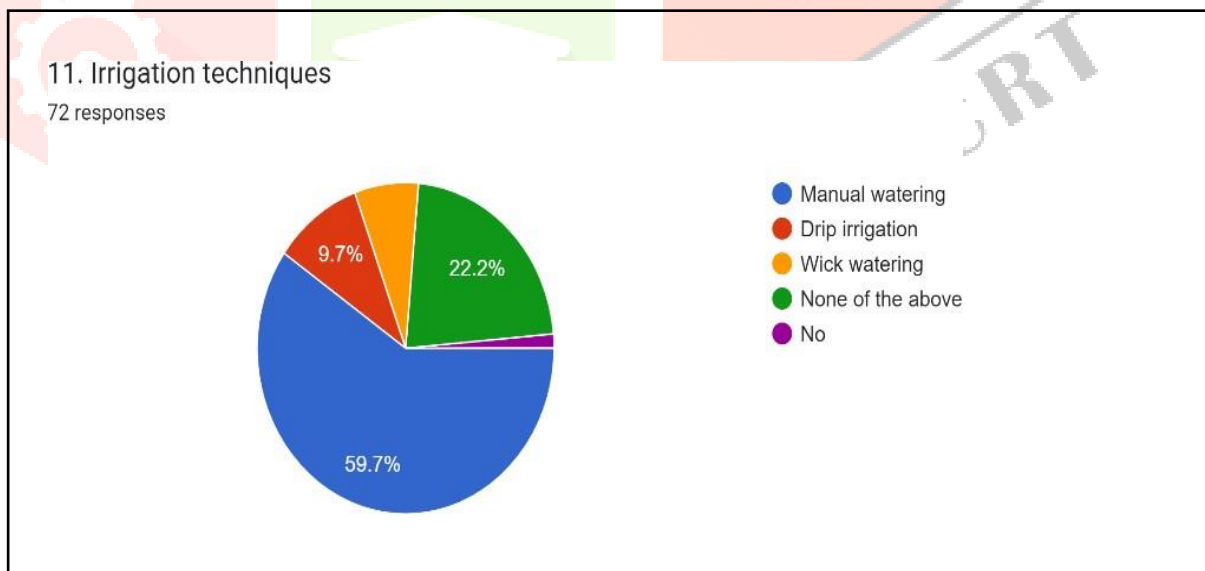
The study reveals that 8.3% are using Grow bags as medium and 55.6% are using mud pots, and 11.1% are using other medium and 25% none of the above.

### 8. Manures and Pesticides used in Rooftop Garden:



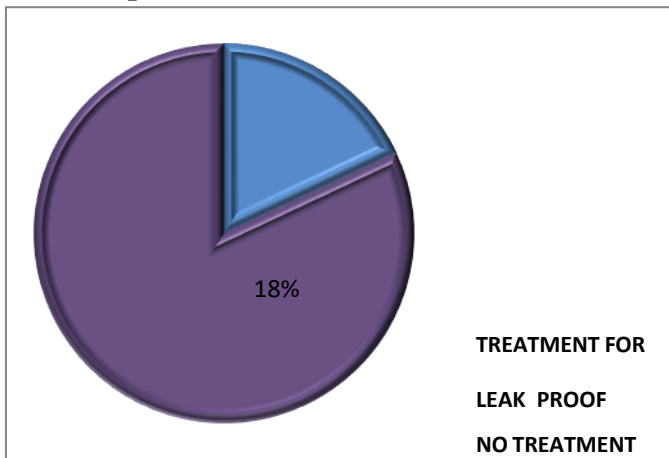
The study reveals that 91% of the families were using organic manure where as 9% of them were using a combination of both organic and chemical manures. While considering pesticides, 78% of the sample were using natural pesticide and only a minority of them were using chemical pesticides (7%) or both organic and chemical pesticide (2%).

### 9. Type of irrigation Practiced in Rooftop Garden:



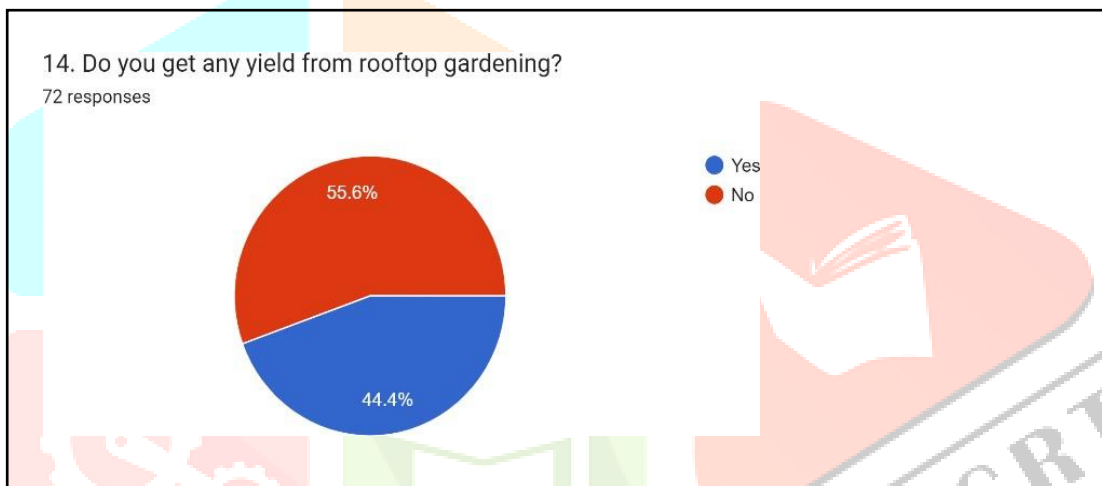
There are different types of irrigation methods used in rooftop such as, manual method like watering with hose, bucket and mug, advanced methods like drip irrigation, wick irrigation etc. The result shows that the irrigation method used by majority of families were manual (bucket and mug), ie59.7%, 22.2% of the families use drip irrigation , 9.7% practiced drip irrigation and only 8.4% practiced wick irrigation as method for watering.

### 10. Leak proof treatment for Terrace



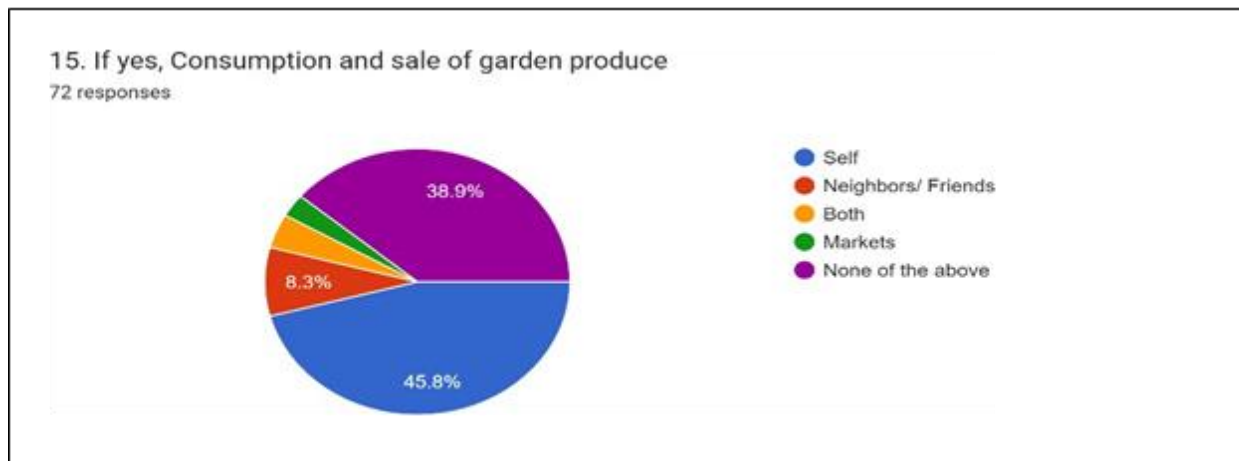
The study result shows that 82% of the families has not taken any treatment to protect their terrace leak proof while 18% of the families did some treatments for the protection of roof.

### 11. Yield from Roof top Gardening:



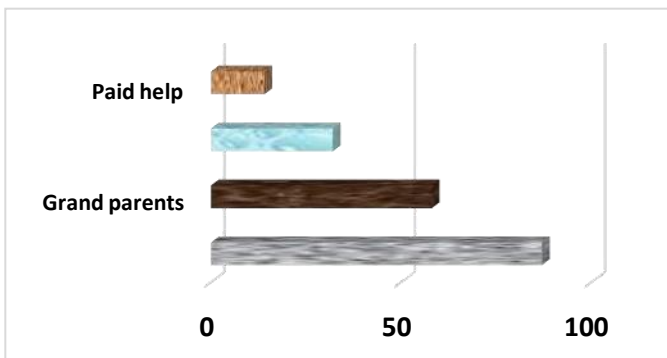
The study reveals that 44.4% Of the respondents got yield From gardening and 55.6% Got no yield .

### 12. Consumption and sale of Yield:



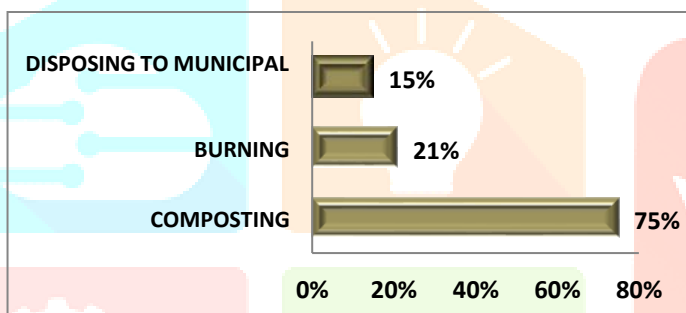
The study reveals that 45.8% of the families are using the yield for themselves and 8.3% distributed the produce to neighbors and friends . A minority of 3% were selling their products outside.

### 13. Persons involved in Maintaining Rooftop Garden



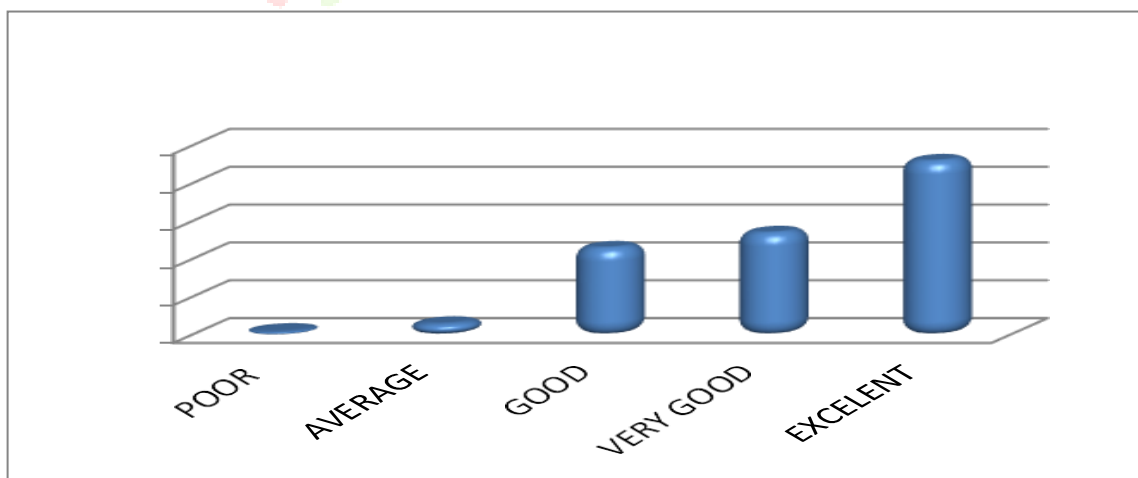
Gardening is mainly a leisure time activity where all family members are together doing garden work. But, one person take the leadership in maintaining the garden. The study result convey that in majority of houses (87%) the rooftop garden is maintained by the father/mother, in 9% of the houses it is maintained by children, in 3% houses garden is maintained by grandparents and in 1% of houses rooftop garden is maintained by the paid help.

### 14. Disposal of Garden Waste



While analyzing disposal practices of garden waste, it is found out that 75% of the respondents were managing their waste from rooftop through composting, 21% of them burn the waste and 15% were disposing the waste to municipal waste bin.

#### A. 15. Satisfaction derived from Rooftop Gardening



Organic farming has been a way of life for man since the beginning. Harvesting and growing one’s own food has always been a necessary resource for man, especially in this pandemic condition. Gardening

reduce the stress level and provides fresh mind and healthy body. From the above figure it is evident that 47% of the sample feels excellent/full satisfaction, 27% feels very good, 23% graded their satisfaction level as good, 3% of the sample the satisfaction level is average where as 1% of the sample felt unsatisfied for their rooftop gardening.

### **Suggestions:**

Urban regions can benefit from rooftop gardening in many ways, including the economic, social, and environmental aspects. These measures can help build resilient and sustainable cities. Here are a few of the main suggestions of the rooftop gardening:

1. Rooftop gardening is a great way to grow fresh produce, reduce your carbon footprint, and create a beautiful outdoor space in your urban home.
2. Flat roofs are generally the best candidates for rooftop gardens, as they can support the weight of the soil, plants, and irrigation systems
3. You'll also need to make sure your roof is watertight and in good condition before planting anything
4. Lightweight materials, such as geotextiles and recycled plastic containers, can help to reduce the weight of your rooftop garden.
5. Some rooftops receive full sun all day long, while others are shaded by buildings or trees. The amount of sunlight your rooftop receives will limit the types of plants you can grow. If your rooftop is shaded, you'll need to choose plants that can tolerate low light conditions.
5. Use organic compost
6. Making it mandatory to grow plants and teaching the next generations about the importance of the plants before they see them at museums.
7. Save plants, save Earth because oxygen is very much important to our life.
8. Schemes to start own business regarding gardening.
9. Plants in rooftop gardens help filter and collect airborne contaminants, such as gases and particulates, which improve the air quality of urban areas.
10. Rooftop gardens offer chances for socializing and participating in the local community.

### **Conclusion:**

Rooftop gardening offers a viable option for sustainable urban agriculture and its adoption can help build the thriving, resilient, and sustainable cities of the future. Urban places can harness the power of rooftops to nurture green areas, advance food security, and enhance the wellbeing of urban residents by adopting this contemporary method of production. rooftop gardening offers a cutting-edge strategy for food production in cities, solving a variety of issues and offering several advantages. This sustainable method helps to build cities that are healthier, greener, and more resilient. Rooftop gardens can be effectively installed and maintained with careful planning, community involvement, and creative design.

### **References:**

1. MacRae R, Gallant E, Patel S, Michalak M, Bunch M, Schaffner S. Could Toronto provide 10% of its fresh vegetable requirements from within its own boundaries? Matching consumption requirements with growing spaces. *Journal of Agriculture, Food Systems, and Community Development*. 2010 Dec 10;1(2):105-27.
2. Harada, Y and Whitlow, T.H (2020). Urban Rooftop Agriculture: Challenges to Science and Practice, *Frontiers in Sustainable Food Systems*, <https://doi.org/10.3389/fsufs.2020.00076>.
3. Jafari,N, Utaberta, N, Yunos, M.Y Ismail, A, Ismail, S, Ariffin, N.F.M, Jafari,N and Valikhani, M (2015). Benefits of Roof Garden In Order to Usage of Urban Agriculture at Roof Garden in High-Rise Building in Malaysia, *Advances in Environmental Biology* , Research Gate, 9(24) November 2015, Pages: 86-91, retrieved from <https://www.researchgate.net/publication/286622973>
4. Blanchard CM, Raja S, Nagarajan G. The potential of urban agriculture for sustainable food production and environmental conservation: A review. *Sustainability*. 2019;11(19):5308.

5. Berardi U. Green roof energy and water-related performance in a temperate climate. Building and Environment. 2015;83:11-27.

