



MAJOR CONSTRAINTS OF URBAN ROOFTOP FARMINGS ARE DIRECT OR INDIRECT EFFECT TO THE PERCEPTION OF URBAN PEOPLE IN BHUBANESWAR.

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To my production stage

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To my transport stage

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ABSTRACT

The continuous growth of the human population in India and urban people is increasing a lot of food security. Urban agriculture was one of the important cultivates to produce fresh food on our roof. It plays a vital role in production of vegetables, flower ornamental and fruits. The rooftop garden (RTG) is a landless cultivation done on roof ,terrace, balcony and hanging method. No exclusive need to construct a garden at the ground level. Roof gardens can be splendid substitutes for natural looking, landscaped areas at the ground level. With some imagination and fantasy, a flat roof can easily be turned into a green roof garden. Numerous rooftops of a city can be transformed from a barren landscape into a living network of gardens. A green roof is a contained ecological oasis for nature on top of human-made structures and it constitutes an environment that is very different from a garden rooted in natural soil at ground level. Rooftop gardening is a special type of urban agriculture or urban horticulture. Standing on one of the higher floors of a building, one sees immediately how extremely large the total surface of the roofs in the city is. These roof spaces are generally unused. They often have good exposure to sunlight and rain, and they are always available, even in the densest urban areas. Whether in the rain or the sun, a roof garden always has a lot of character, changing with the season and the time of day, so it will be visited regularly. One of the most important reasons to create roof gardens is the esthetic view of a green area in the city, which is contributing to the quality of life of the citizens. Green roofs absorb stormwater, reducing runoff by at least 50 % and filter polluted runoff water before it enters in drains, rivers and lakes. Pollution is sucked out of the air by plants in the garden, thus reducing air pollution and dust. Roof gardens are one of the most innovative and cost-effective ways cities can use to improve the degrading urban environment. Roof gardens have been proven to reduce the effects of the urban heat, the result of sunlight reflected off concrete and other reflective materials, which can make summer air in dense cities up to 10 degrees hotter than in rural areas. More energy has to be used to cool buildings and more air pollution is created in the form of smog. Rooftop gardens keep buildings cooler in summer and warmer in winter. Air conditioning costs are cut down and roof gardens can cool the whole city by several degrees in summer.

KEYWORDS-: ROOFTOP GARDEN, ROOF LOAD, SUBSTRATES USED, CONTAINERS, ROOF CONSTRUCTION FOR GARDENS

INTRODUCTION

Green roofs are attractive and ecologically beneficial, They offer several practical advantages to an uncovered roof. The reduction of runoff water (no peaks of rain water to be evacuated through drains). The protection of the roof construction against mechanical and thermal effects (isolation for U.V. rays of the sunlight and temperature changes). Buffering against heating in summer and cooling in winter. The absorption of noise. The creation of new ecological sites for settlement of local flora and fauna in the city, since a lot of species are brought in by wind and birds. It can also be interesting to explore the economic potential of cultivating food crops in these urban spaces. Roof gardens can easily be integrated in the design of sustainable systems for green areas or food production within human settlements. They are small-scale alternatives to gardening, reforestation, and landscaping or even modern industrial food production systems.

Since the 1980's, they are very popular in Europe, e.g. Germany, Switzerland, The Netherlands and Belgium and they have now started to make their way in North America and Canada, as people begin to realize and take advantage of the widespread benefits that green roof infrastructure offers to cities. In Europe, there are also bylaws: governments put taxes on runoff water. Therefore, many people green their roofs to avoid these taxes. In New York City, the authorities are nowadays looking at comprehensive green roofing for all of lower Manhattan. One can have visions of covering a city's vacant roofs with vegetation. It should be known by municipal authorities that rooftop gardening is having a lot of benefits. It has the potential to serve local needs in many circumstances. One of the greatest benefits of rooftop gardens is their nearness to the citizens. People with a cultivated roof space on their house do not have to travel to a public garden or an urban park. Roof gardens on community centre roofs or big warehouses, for example, could help visitors to find a relaxing green area in their immediate neighborhood. Such "community roof gardens" are not likely to face competition with other uses of that open space and can therefore offer greater security of tenure than other spaces. A rooftop has almost no vandalism.

STUDY AREA

Bhubaneswar is [20.27⁰N 85.84⁰ E] an most populated metro city in India's eastern state of Odisha. Bhubaneswar is called as temple city and capital of state Odisha. Due to the India declared smart city, smart farming is growing on the rooftop. Farming is one of the interesting cultivation in Bhubaneswar city of India. Bhubaneswar is a densely populated city of India. It contains a large space of roof. The people of Bhubaneswar are very much interested in soilless cultivation on rooftop, terrace and balcony farming. The climate of the area is highly humid and cyclones are affected from the bay of bengal sea. I am chosen for the research area because of the growth of rooftop farming from 20 century.

MATERIALS AND METHODS

The material and methods are on the basis of a survey of rooftop practitioners of the Bhubaneswar. data is collected from rooftop farmers by questionnaire method.

RESULT

PROBLEM NO- 1: WHAT KIND OF ROOFTOP GARDEN WILL BE INSTALLED?

It should be kept in mind that the construction of roof sites determines the type of rooftop garden to be installed. Different types of roof gardens exist: extensive and intensive ones. To be sustainable, an agricultural or horticultural Endeavour must conform to the environment of which it is a part. This environment is normally ecological in scope, with some social and economic dimensions. The choice of the type of garden depends largely on the special characteristics of the roof area. Extensive roof gardens have thin substrate layers (3-15 cm of soil depth). They normally consist of mosses and herbs, e.g. aromatic species, and are built primarily for their environmental and economic benefits rather than public access. They can also be planted with succulent species (e.g. Sedum) or many species of grasses. They do not require a strong roof construction or a lot of maintenance. The Sedum roof gardening method is environmentally friendly and possibly the simplest and safest one, even in rainy and windy seasons. It doesn't have any influence on concrete roof floors. A Sedum mat or roll has an average of 1000 to 1200 little plants/m². It keeps its green outlook all year long, turns nicely yellow when flowering and prevents direct heating of the roof and weed development. It only needs a thin (3 cm) and light weighted sandy soil (25 kg/m²). There is almost no need for extra watering, which makes it a very economical method. Non-woven fabrics or synthetic tissues secure enough water to keep the Sedum or other succulent plants growing. We were told that one or another Chinese company is already producing these Sedum-mats or rolls. From the theoretical point of view, I would highly recommend such mats or rolls on all roofs that do not have a strong construction. Moreover, I would like to recommend incorporating our Terracotta soil conditioner, commonly called TC, in these mats. This will certainly enhance the water retention capacity in the thin mat and create a denser root system for a better overall plant development. Should the mats be placed on a roof covered with bitumen, an anti-rooting membrane will be needed to avoid the Sedum roots to penetrate in the protective bitumen layer. Solid structural fibers can drain surplus water and create a good environment for growth of succulent plants. Among all succulents, a Sedum mat shows the best resistance to drought and low temperatures. Weeding is not necessary. Maintenance is very easy, because there is no need to prune

or mow the low plants. TC soil conditioner will help Sedum or succulent rolls to solve the major problems of roof gardens on any building in the city. Intensive roof gardens are planted with a large number of different species (trees, shrubs, herbs and lawn). Even little ponds with fountains can be installed. They need a rather strong roof construction, because of the extra weight of the drainage, soil layers, plants and possibly containers. Normally, these gardens need a substrate layer of 20-50 cm, which constitutes a minimal weight of 200 - 300 kg per square meter. Nevertheless, lightweight systems for substrate construction have been developed. It should be understood that the application of the TC-method contributes significantly to limit the weight of the substrate. Indeed, the TC soil conditioner, mixed into the root zone, considerably enhances the water retention capacity of the soil and thus, less soil is needed to have an excellent root development. And more roots means also better plant growth!.

PROBLEM NO- 2: THE ROOF LOADING.

Most buildings and houses built in towns or cities after 1980 are constructed with bricks and concrete or with a cement frame. Engineers and designers did not think of foreseeing the installation of a green roof at that time. A discussion with the original constructors on roof loading is necessary when planning installation of a rooftop garden. There are two types of roof loading: dead load and live load. Dead load refers to the weight of the roof structure itself and any permanent structures on that roof. To accommodate weights beyond the dead load (from snow or rain water), buildings are normally designed with a “live loading capacity”. This is meant to bear the weight of snow in the winter, but rooftop gardeners can use it during the summer, e.g. to take into account the total weight of the roof garden and the retained water. Unfortunately, most formerly constructed roofs are not designed to support an “intensive garden” with a massive substrate layer and big plants. Only an “extensive garden”, with a thin layer of soil, mosses, herbs, Sedum or other succulent plants, seems appropriate here. On the contrary, a modern buildings’ roof should always be planned to support the weight of a garden.

PROBLEM NO- 3: THE WATER SUPPLY

Normal gardens at the ground level, built in newly developed parts of the city, may have some trouble accessing water. Roofs of modern buildings, in contrast, are almost always close to possible supply of municipal water or tap water from the top floor. However, collecting rainwater for plant production is more appropriate than using urban water. On the contrary, in older parts of the cities, irrigation systems for watering plants in a roof garden may be absent, which makes its maintenance very difficult. Therefore, one should firstly look for a good solution for this major problem. Here, the TC-method to stock water in the root zone can help in a significant way. We will discuss its effect shortly later on. Finding possibilities to harvest and store rainwater should always be a priority for anyone developing an urban garden. It is incredible how quick the soil of a roof garden is drying out and plants will wilt very often if regular watering, early in the morning or late in the evening, is forgotten. During summertime, watering should never be done in the middle of the day. As low annual rainfall is directly affecting plant growth in a roof garden, it can be necessary to have access to the municipal water supply, e.g. for drip irrigation. Collecting rainwater for ulterior irrigation can pose a problem, as there is generally no suitable room to store a large vessel. To provide adequate pressure in the drip irrigation system to be envisaged, a gravity-fed hose will need a supply tank installed much higher than the hose outlets. Another problem would be pumping tap water into this supply tank if it were situated on the same roof. The weight of the tank would have to be distributed evenly over a considerable area to reach the live-load limit of the rooftop. These factors can make the irrigation system and water collection impractical. The trouble can also come at the other end of the spectrum, i.e. there could almost be too much water. Therefore, one should preferably look for an adequate system to enhance the water retention capacity of the substrate in order to continuously stock sufficient volumes of water to avoid drought stress. The possible surplus of water during storms should be easily drained. The quantity of water retained in the substrate, must be readily available to the plant roots to avoid wilting of the plants over a longer dry period.

One of the best methods to stock water and fertilizer in the substrate of a roof garden is called the Terracotta or TC-method, developed at my Laboratory of Plant Morphology at the University of Ghent (Belgium) in 1983-1992. It has been applied since 1995 in China (Greenhouse project in Lanzhou, Gansu Province) and it has proven its effectiveness in different Chinese provinces since then. The TC soil conditioner is a mixture of more than 20 granular substances, all assisting plant growth in a synergetic way.

PROBLEM NO- 4: LIGHT AND WIND

If there are no overhanging trees or tall buildings in the area, roof gardens mostly have maximum exposure to sunlight. There can be some trouble with heat in the roof garden, due to over-exposure to sunlight, and therefore one should look for means of keeping heat-sensitive plants cool. Some form of shading can be necessary. Sheets of latticework can be helpful, providing enough shade to keep the plants cool and moist during the hotter parts of the day. Wind is generally more of a problematic issue on a rooftop than at ground level due to increased exposure, which contributes to the drying and sometimes mechanically damaging effects of wind. A protective wooden screen or lattice, if possible a hedge of shrubs or trees, can be very useful to break the wind, still offering aeration during hot days. Such a screen is the ideal place to install a bench or chairs for visitors. A shade providing roof can be produced with climbing plant species, even with grape producing vines. On a roof garden, wind is always a bigger problem at the edges than in the center. Therefore, tree saplings should be attached to supporting poles. We would like to recommend growing trees and shrubs in containers, in order to avoid damaging effects of the roots to the anti-rooting membrane. Application of TC soil conditioner to enhance water retention and fertility will lead to numerous success stories.[Fig-1]



Figure-1: Threat of cyclone to damage of rooftop garden Bhubaneswar (cyclone funy)

PROBLEM NO-5: ACCESSIBILITY OF A ROOF GARDEN

Access to the roof garden area should be easy. Open outer edges should be provided with a railing, especially for children. Sometimes, window-like screens are used to keep a maximal clear view at the horizon. Higher plants and containers should be placed along the outer edges of the roof garden, because the walls of the building have a higher carrying capacity.

PROBLEM NO-6: PLANNING AND DESIGNING A ROOF GARDEN

Before planning a roof garden, all engineering consultations on the strength of the roof should be completed.

A number of questions should firstly be answered:

- How to organize the roof garden (what are the wishes of the owner)?
- What kind of plants will be used (dimensions, light or shadow, etc.)
- How will the substrate be built (covering membrane, drainage system, anti-root sheet, soil type, soil layers)?

- What kind of irrigation system will be installed ?
- What are the planting schedules to be followed ?

Although the same principles as for a normal garden should be followed, special attention should be paid to the orientation of the roof garden: sun, wind, windows, doors and available space are essential factors

PROBLEM NO-7: DRAINAGE OF THE ROOF GARDEN

Drainage can easily be installed with a stony layer, preferably uniform in colour. White stones reflect sunlight too strongly. Yellow or brown stones are more in harmony with the vegetation cover. Instead of little stones, polyurethane chips or foam chips can also be used.

PROBLEM NO-8: WHAT KIND OF SOIL OR SUBSTRATE TO BE USED?

This essential part of a roof garden has some very special, almost contradictory requirements: the soil should be extra light, but still have sufficient water retention capacity. It can be composed of two parts of potting soil and one part of peat, with compost, perlite or vermiculite and some fertilizer. Soil used for constructing a roof garden should be tested for contamination before any cultivation is planned. It should be taken into account that substrates with TC are automatically lighter because of its water retention capacity. In many cases, soil is not spread directly over the surface of the roof, where it can be washed away, but it is preferably kept in some form of container. Almost any container can serve: buckets, baskets and big flowerpots are commonly used, but even old bathtubs and garbage bags perform the duty. Wooden containers should be avoided. It is preferable to use containers in light-weighted concrete blocks, which are easy to manipulate. The containers have to be placed on a low support, e.g. used pieces of plywood to distribute the wet-container weight over enough area. Every container has to be perforated at the bottom to allow drainage. It is vital that the roof's drainage pipes are not clogged with garden soil or compost particles. To prevent soil from draining out of the roof frame, straw or coconut fibers can be placed around its inside perimeter, in the corners, and over any gaps. Nevertheless, these organic materials will also decompose after some time, which can lead to new problems. Therefore, synthetic tissues can bring a solution. Roots should be prevented from reaching a roof's bitumen, as they can penetrate and damage it. Therefore, some form of bottom layer is required, e.g. a layer of polyethylene plastic sheeting, called an anti-rooting membrane. The planting beds are to be filled with soil to the required depth because of weight limitations, depending upon the flat roof's minimum live load. The guiding principle for the soil in a roof garden is: the thinner the root layer, the higher the need to irrigate. Crusting can be a small problem, especially in gardens lacking a mulch layer. It can be problematic because a hard surface crust can prevent the quick absorption of water and encourage run-off. A mulch layer is very effective at retaining moisture. Mulched beds will take 100 % more time to dry out. Mulch has also a beneficial effect on the soil: it prevents the crusting. Finally, the mulch keeps the soil beneath it noticeably cooler than exposed soil. Organic matter in the soil will gradually increase when plants are growing.

PROBLEM NO- 9: THE USE OF NUTRIENTS (FERTILIZER)

Most of the crops chosen should do well in the thin layer of soil they are growing in. Nutrients should be replenished from time to time, so that no obvious nutrient deficiencies are manifested in the appearance of the plants. Application of the TC-method offers a very interesting advantage: only 50 % of the normal dosage of fertilizer has to be applied after several months of plant growth. This is due to the fact that nutritive elements of the fertilizer, dissolved in water, are not leached to the drainage system of the roof garden, but are stocked in the water absorbent hydrogels of the TC compound (www.terracottem.com). Root tops stick to these gel lumps with their root hairs and can pump the available solution, loaded with nutrients



Figure-2: Threatened on water slippages on roof

PROBLEM NO-10: THE ROLE OF ROOF GARDENS IN AIR POLLUTION

Concerns may be expressed about urban air pollution and its potential effect on the safety of the plants in a roof garden. It seems that air pollution is unlikely to have any influence on the plants at this site. Collected data indicate that most of the toxins collected by plants come from the soil rather than the air, e.g. the amount of airborne lead has dropped significantly with the phase-out of lead in gasoline. On the other hand, leaves can collect an important quantity of polluting particles and dust from the air in the cities.

PROBLEM NO- 11: THE RIGHT CHOICE OF PLANT SPECIES

As it depends upon a number of parameters (dimensions, drought resistance, pH, exposure etc.), the choice of plant species for a roof garden is very important. It may take an experienced gardener to know which perennials plants will perform best in such a special environment. Low-maintenance plants are grown in a multi-layered lightweight system, which includes a root-repellent membrane to prevent plants from rooting in the roof, a drainage system and a growing medium that is lighter than the soil used on the ground. The dimensions of the adult plants should be taken into account, but also their possible resistance against drought and full sunshine. Another important factor is the pH. Acidophilic and acidophilic plants will never grow together on the same soil. Plants and soil against a wall begin to wilt and dry out much sooner than those only a few feet away, because of the considerable heating of the wall by the sun.



Figure-3: Short time hybrid vegetables grown in RTG

Nevertheless, even the best plants can fail. This is particularly true for roof gardens, which are so dependent on external factors. Trial and error seems to be the only way to integrate a roof garden into a local environment. Most of the local plants can grow well in a roof garden. Taking into account some limitations, e.g. dimensions, many trees, shrubs and herbaceous plants can be grown in a normal way. It might be interesting to know that also most of the vegetables can be grown in a rooftop garden (urban agriculture or horticulture). Restaurants or catering companies could use their own roof spaces to produce rare or expensive ingredients for their kitchens, like delicate ones, or those perishing too quickly to be shipped in from elsewhere (edible flowers for example). Strong rooftops would have the most potential for generating an economic return. The labour required would not be great. Moreover, a roof garden can serve other goals while generating income on the side. In most of the roof gardens, weeds are only a minor problem. Owners of a roof garden generally come up with some questions about pests and garden fauna. Will pests invade the garden? Will some birds or other animals eat the seedlings or young plants? Will there be enough insects for pollination? After a certain period of time, a number of beneficial smaller animals will be found in the garden, including numerous species of spiders, wasps, bees and beetles and their larvae. These will no doubt play an important role in keeping aphids and the larvae of butterflies and moths in check.



Figure-4: Best choice of Containers in RTG

DISCUSSION

In rooftop gardens various types of barriers are affected by the perception of urban people. The results we discussed above are the results taken by the survey of people which are well established on RTG by means of Questionnaires by door to door visits during my project work. We collect data through the interaction of RTG stakeholder in different regions of Bhubaneswar. Some people think that lack of technical knowledge for cultivation on roofs is about 33% and fear of heavy load 69%. It is the very important constraint of Rooftop gardens. As per open field the roof has not sufficient space for cultivation in the roof that is 40%. Water slippage also carries out in Rooftop garden about 30%. Other barriers are Availability of raw material for cultivation, Disease to the plant, climatic change, production quantity and wild and domestic animal damage to the plant. Containers are stabilized on the roof. These are the other reasons for constraint RTG. Apart from that the proper maintenance of RTG gives a number of opportunities and scope.

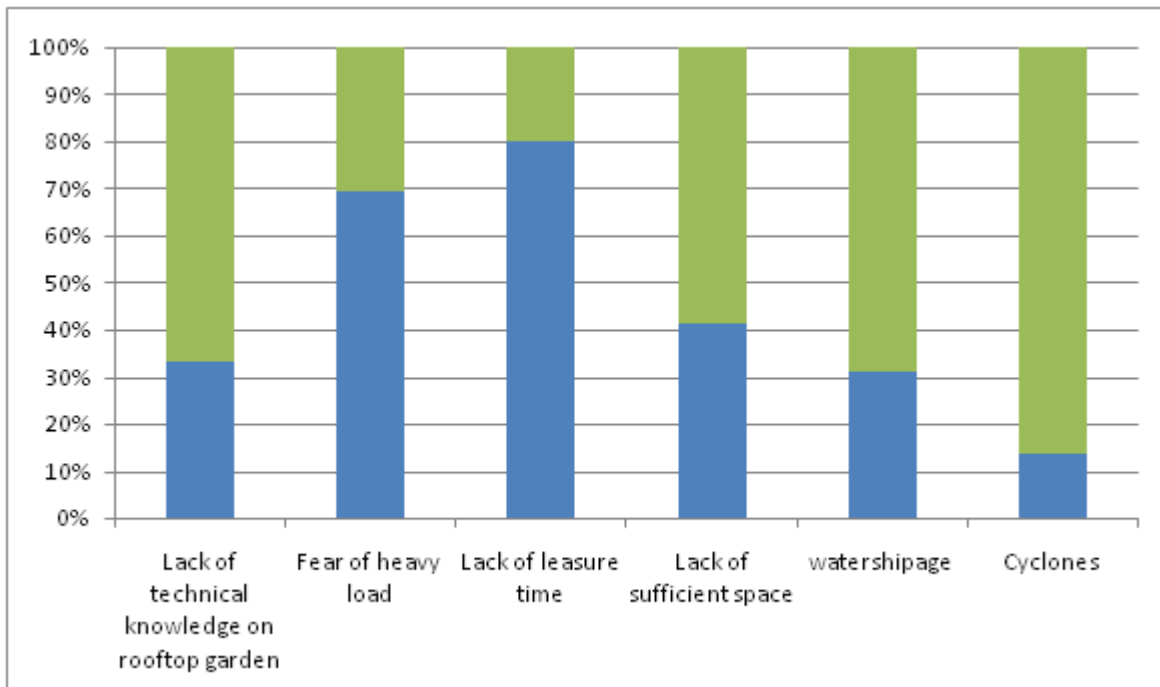


Figure-5: Important constraint of roof top garden on survey report in Bhubaneswar

Urban people are very interested in rooftop gardens due to the effect of contaminating food and essays to cultivate on rooftop. The barrier of rooftop gardens is going to solve various expertise, roof designers, engineers and RTG practitioners. As per condition of the roof can be utilized for RTG in future implementation of RTG will be very rapid in urban agriculture. The barriers are create discrimination among Urban RTG practitioner for perception. Simple solution is taken for the RTG .

CONCLUSIONS

Urban People in Bhubaneswar are very sensitive to cultivate RTG. Taking into active interest the existing roofs in different cities, the installation of both extensive and intensive roof gardens can be programmed. Engineers and roof gardeners should work together to enable the construction of many roof gardens possible before 2018. Specialized companies, organizations and nurseries should contribute to this installation of roof gardens with appropriate materials, adapted soil mixtures and plant species. The Bangalore based company builds up the different containers and grows bags as per the structured buildings. Available for answering any question or technical advice concerning the possible incorporation of its soil conditioner into any new roof garden. Bio fertilizer companies are suggested to all urban people of Bhubaneswar along with all city people involved in the promotion and construction of rooftop gardens. I have the honor and pleasure of wishing you all the best and a lot of success with your initiatives in the future. In India RTG rapidly grew RTG in the state of Kerala Maharashtra Karnataka and even capital of India Delhi. Odisha is aware that in Bhubaneswar interest level is gradually growing in modern age.

METHODS-: NOT APPLICABLE

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