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ROOFTOP FARMING CONTRIBUTE A NEW STRATEGY FOR ENHANCE FOOD SECURITY: STUDY IN TEMPLE CITY BHUBANESWAR, INDIA

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ABSTRACT

Agriculture meets new technology for growing food by urban people through Roof Top Farming (RTF). Rooftop farming is the main source of fresh and pure organic food. Urban people have knowledge about chemical based food from the vegetable markets. So they are practicing rooftop farming which is very essential for Bhubaneswar city. They implement for organic farming to produce organic vegetables on own rooftops. Landless urban people perceive rooftop farming on their building and meet daily needs. Cultivation will become challenge to urban people. People suffer hazardous chronic diseases lack of Organic food and spend more money. Food security need for urban people behalf of rooftop Farming. Cultivation of vegetables and fruits on rooftop is essential for new generation for enhance food security. Food production and consumption in urban areas has become a global challenge. Urban people obtain fresh food from rooftop farms. Survey reveals that the people are cultivate on rooftops, balconies, Terrace with containers. We have chosen Bhubaneswar, capital of Odisha, one of the biggest cities of India, for study due to large number of rooftop farms is established. The main objectives are to cultivation of plants, diversity, food security and economical value of rooftop farming.

Keywords **:** Rooftop farming, Food Security, Organic Food, Economic value,

Introduction

The population and building of Bhubaneswar city is growing very rapidly, the demand for food and expenditure on food is also increasing but the resource is scarce as agricultural land is converted to residential, commercial or industrial land uses. It increases rapidly agricultural food products. Again food contamination such as harmful chemical usage to ripe fruits, hazardous or inorganic fertilizer and pesticide use to increase production, etc. In these circumstances solve these problems and find a way out, initiation of rooftop farming can be a possible and potential solution. Rooftop farming can help to meet food demand by supplying fresh and hygienic food products, reducing household expenditure for buying vegetables and fruit (Whiltinghill and Rowe *et al*., 2013; Alaima and Packntt, 2008) saving cost for the municipality by storm water retention, creating a healthy atmosphere by improving air quality and absorbing carbon from the air and lessening the impact of climate change. But this is not possible to implement on a large scale without government provision. But other cities can also practice and may get similar benefits. In other countries that have a scarcity of cultivable land like Bangladesh can also practice rooftop farming to increase greenery and supply fresh food (Altieri *et al*., 1999). Further work such as measuring the benefits of rooftop farming in local, regional and national contexts, standardizing the constant factors of monetary valuation, developing a replicable rooftop farming model is possible with the help and guidance of this report (Wikstrom, 2017). As population of Indian cities are growing population need higher demand for food and expenditure. The scarcity of resource for agriculture is land. Because land is going to less due to residential, commercial or industrial propose (Alkon and Mares, 2012). Again food contamination such as harmful chemical and inorganic fertilizer and pesticide uses to increase production. In this circumstance to solve this problem is very difficult task for urban people. Rooftop vegetable farming can help to meet food demand by supply fresh and hygienic vegetables. (Mengual, 2019; Suparwoko, 2017). Nowadays rooftop gardens grow very rapidly because of decrease of organic foods. Bhubaneswar is one of the smart cities now growing rooftop farms successfully. They have good opportunity to prepared rooftop farms. Pure chemical free fresh vegetables and fruits are easily cultivated from rooftop farms.

Materials and Methods

Plants are cultivate on rooftop, terrace and balcony farming and collected relevant information by Survey and statistical methods. Data (primary and secondary) are collected from different sources. The primary data are collected from rooftop practitioners. The secondary data are collected from the internet, media, and news paper, journal, and organizations etc. gardeners. A questionnaire prepared respondent stakeholder and responsible authorities of selected public and commercial buildings investigated the viability of rooftop gardening (RTG). In addition, there was also a focus group discussion where participants were invited

to discuss the city's rooftop gardening opportunities. City crop land and house owners and the general public were asked to express their opinion Primary data collect from the doorstep of Gardeners, practitioners, by discussion and questioner. Secondary data collect from expert's technicians, researchers, data base, Online etc. The method of study is the basis of field surveys and questionnaires. Photo is taken door to door steps of different zones of Bhubaneswar. The rooftop practitioners are given opinions about balcony and terrace gardens. The method of study is on the basis of survey and observation.

Result

Due to the various opportunities urban people are interested to rooftop farming. Rooftop is the best example of integrated farming developed in urban agriculture (Astee and Kishnani, 2010). Urban agriculture plays an important role for food production. Rooftop kitchen garden provides vegetables, fruits, and spices (Figure-1). Professional people are gradually adopted rooftop farming. Due to large number of opportunity like food security, Environmental benefits, waste utilization, water management etc. Containers are used in rooftop farming such as poly bags, grow bags, plastic pots, soil pots (Badmi And Ramankutty, 2015). Rooftop gardens require less water and soil (Taylor and Lovell *et al*., 2013). Containers used on rooftop reduce space of roofs. (Sharif Islam, 2002) Irrigation facility is become easy to cultivate. Storm and rain water is also used directly on rooftops. During covid-19 pandemic rooftop gardens play a very important role for protection and food security (Despommier *et al*., 2010). Rooftop garden, balcony garden, terrace garden are an important part of urban agriculture which provides organic fresh vegetables to the kitchen. The rooftop garden is a garden on the roof. This means that each roof is covered with plants such as trees, shrubs, and bushes and grasses (Morgan and Sonnino *et al*., 2010). Roof gardening can also be defined as 'environment or nature in the sky. Green roofs are roofs of buildings covered with a growth substrate and plants, which are also known as roof gardens, living roofs, and eco-roofs (Freisinger and Specht, 2015). Urban communities face many challenges related to the health and well being of citizens. Many of these challenges arise as the direct consequence of dense urban environments. Industry, automobiles, and impermeable concrete and asphalt surfaces combine to negatively impact upon the air and water quality, while due to climate change there is a continuous increase in the atmospheric temperature because of global warming thus rooftop farming contribute to nutritional security.

Fig. 1 : Vegetables cultivation on rooftop farm.

Fig. 2 : Technique of vegetable cultivation on rooftop farming

Fig. 3 : Fruits cultivated on rooftop farm.

Plants grown on rooftop farms

The containers used in rooftop gardens are pots, buckets, containers, poly bags and bottles or raised beds which contain a soil-based growing Involve medium. This medium can be made up of mixtures of soil, Compost or wood chips. Rooftop containers can range from simple pots to more elaborate systems. As much as possible locally available and recycled material could be used. Different companies manufacture varieties of containers for rooftop gardens (Resh *et al*., 2012). Almost all vegetables and certain fruits are easily cultivated in containers for better yield and production Figure 3. Fewer amounts of water are used in containers. The water dripping system can be installed in the containers. Containers are commonly used to commonly poly bags, grow bags and plastic pots etc, Figure 4.

Fig. 4 : Container used on rooftop farming

Growing vegetables on a good balcony can be the seat of pots. Vegetables, flowers, ornament cultivation on utilization of ventral pots of different type of which the amount of light and winds is a major factor of consideration while planning the garden and selecting plants. At present the human population- predominantly rural unites and now the half way make to urbanization. Today over 50 percent of people live in towns and cities (Marris *et al*., 2002). Although they occupy less than two per cent the earth' s surface, but use more than 75 percent for the center of its resources it is also commented some time that the city dwellers are; ecological parameters consuming more natural resources of the world. These cells for tops or terraces of the balance, though cultivating crop plants on the urban house of rooftops or terraces, provide food security (FAO, 2013a) city arrange the gardens. One good step is to prospect and on a happy note it is already on the rise (Thomaier and Specht *et al*., 2018) the notable example world is that of a densely populated Hong Kong wherein 45 per cent of local vegetable needs are reported to be met through insensitive cultivation on six per cent of the land space including terraces buildings. Planning of the balcony garden and selection of plants should be completely in accordance with the available sunlight and wind speed. First observe how much life is available on the balcony in the colony during the day and which direction it comes from.

Fig. 5 : Organic vegetables grown on rooftop farm.

Watering the plants in the balcony needed to be done carefully, watering the balcony garden may become if you have a lot of post and have to carry a large quantity of water in containers. Adopts smart operations for watering like fixing a close water source and connecting a small household house and the other operation in connecting a drips irrigation system available in rooftop gardens. The variety of drips line self-watering spikes which can be attached to bottles. It can be used the setup can unused water supply to the plants for a few days when you outstation. One problems which at the point where the water drops floss and the other side of the pots of not being utilized fully, this problems must be address by occasionally adjusting the points where water drops water drops falls. This irrigation delivery method number of applications, and total irrigation amount varies depending on the specific crop requirements, spray and dripping system.

According to the space available in the balconies will be normally very less compared to other gardening style maximum utilization of the available space of must be done two away this using trade plants stand than display may plants of small are of the hangs ports of boxier or rivaling .user boxes that can be stacked consider use for growing edible. Here and vegetable great three mixed a annual or to display will to as partial one .if more than 30sq is available all parts /poly bags can be kept on the vertical arrangement will be more effectives in advise kept them grow bags, it is advices to keep the floor case of maintained and clines growth bags /poly bags should be kept b on arise plate from material farm single step of 2-3 step can be poly bags stragglers shape led or curve material farms can be used according to the space available. Multi-tiered arrangement is useful for displaying the beauty of the flats as well to utilize the available spaces of light balcony rankings, of half wall less can be utilized for hanging pots and through containing and small ornamental plants. Hanging baskets pots can be hanging from cleaning nowadays wide verticals of gardening material valuable in the market which allows you to utilize every single corner or space in the balcony. Earthen pots, terracotta pots, fibers, glass materials, plastic pots of various shapes and quality grow bags and polythene bags are the different inches to select from. Selection should be done based on the budget purpose and aesthetics value (Orisini and Marthetti, 2004) For growing flowering plants and ornamentals for pots in various size and shape can be selected according to the structure of the plants .for growing common organic vegetables like chilly, tomato, brinjal, vegetable ,crop age pots of grow bags be as standard size so there spaces of proper growth and developments of roots, Figure 5. Which involve growing plants using water based nutrient solutions in place of soil. They require liquid fertilizer inputs. There are exposed hydroponic systems used in open-air settings, as well as hydroponic systems Brown under cover (glass or plastic) to help increase yields and extend the growing seasons.

Nutrient value of food on rooftop farms

Organic method of farming can be adopted as per people's individual interest, for chemical fertilization soluble chemical fertilizer formula caution can be used. Care should be including primary nutrients N, P and K as well as secondary and micronutrients formations. For organic nutrients management nutrients organic source like vermin wash, cow dung supply bio-fertilizer formations, household composed wash can be used a lot of organic nutrient source in the available in the market whose authenticity it is not walls established but most of them are formed to provide good result in respect to growth and yield of plants. Umpteen numbers of organic labels produce bio-fertilizer sewage extract humic acids, ammonic acids etc. Various companies are available for organic fertilizers growers. Vermi-compost is different brand available in markets. Household waste items like kitchen waste can be effectively used as a source of nutrients for the plants. Those who can spend more for their gardens can make their own organic manures using the available materials. A compost bin can be used to convert the kitchen waste to compost a part from the compost the liquid which oozes out of the compost bio-fertilizer seaweed extract humic acid fish amino acid act from various companies are available for organic growers. Household waste like kitchen waste can be effectively used as a source of nutrients for the plants those who can spend more time in their gardens can make their own organic fertilizer and use the available materials. A compost bin be used to convert the kitchen waste to compost a compost from the liquid which oozes out

of the composed cell can be diluted applied soil or given flavor, vegetable fish waste can be performed using bio compost in clean container and can be helped applied to the plants powdered egg shells are good source of the calcium for the plants. Crops should be durable, and capable of resisting wind and other hard climatic conditions are ideal for rooftop gardening. Thin, crisp stems plants should be avoided. Root vegetables, like carrots, radish and turnips are well-suited due to relatively low growth. A thick root also helps to anchor the plants into the ground, providing resistance to wind. Low growing greens, including lettuce and spinach, are also well-suited to rooftop growing, as are some varieties of climbing beans which can withstand for best results, vegetables grown on rooftops should be started in flats or similar containers under screens or netting that will prevent soil from drying out. Amend growing medium with plenty of water to high-quality organic constituents, such as compost; and spread a thin layer of mulch around plants upon transplanting. These measures will help to retain moisture. Rooftop farming is implemented in each and every city and towns of India (Block and Chavez, 2011). They have a safe guard of opportunity obtained from rooftop gardens. Pure and chemical free fresh vegetables and fruits are easily cultivated from rooftop (Morgom and Sonnino, 1010). Thus it reduces the possibility to grow more and different agricultural food products. In this circumstance, to solve these problems and find a way out, initiation of growing vegetables on rooftop can be a possible and potential solution. Rooftop vegetable farming can to meet food demand by supplying fresh and hygienic vegetables. Now a day's Bhubaneswar is one of the smart cities growing rooftop farming successfully. They have a safe guard of opportunity obtained from rooftop gardens.

Fig. 6 : New techniques of cultivation on rooftop farm.

New technique use for vegetables, flowers, Fruits, ornaments plant gardens are grown in containers, lawn, stands, and pots. These are on rooftops, terrace, Balcony etc. of the balance thought cultivating crop plants on the urban house of rooftops or terraces: city arranges gardens. Further one of good step is to prospect and on a happy note it is already on the rise .the notable example world be that of a densely populated. 24 percent of local vegetable needs are reported to be meeting through insensitive cultivation on six per cent of the land space including terraces buildings. Vegetables, leafy vegetables, Flowers, Ornamentals cultivation is important for urban balcony gardens, Figure 7. Use of water is very less because the balcony garden used containers. Diversification of flowers increases the beauty of the building.

Fig. 7 : Leafy vegetables are cultivated on rooftop gardens in Bhubaneswar.

It contains a large space of roof and the people of Bhubaneswar are very much interested in cultivating rooftop, terrace and balcony farming. The main findings are that balcony and terrace gardens play an important role in urban agriculture as well as other opportunities to enhance food security mentioned in the title (Marris, 2002). Planning of the balcony garden and selection of plants should be completely in accordance with the available sunlight and wind speed. First observe how much life available on the balcony in the colony is during the day and which direction it is coming from. Selection of pots Earthen pots, terracotta pots fibers, glass materials, plastic pots of various shapes and quality grow bags, bags are the different clichés to select from selection should be done based on the budget purpose and aesthetics value. The various types of vegetables are cultivated on rooftop farming in Bhubaneswar. For growing flowering plants and ornamentals within pots of various size and shape can be selected according to the structure and length of the plants. for growing common vegetable like chilly, tomato, brinjal, vegetable crop as pots of grow bags as standard size so the three of spaces of proper growth and developments of roots. Green Vegetable- Table-1, Leafy Vegetables, Fruits, Spices.

Tables 1 : Diversity of vegetables cultivation on rooftop farm

S. No.	Vegetables cultivated	Local Name	Botanical name	Family	Parts use
1	Apple gourd	Tinda	*Praecitrullus fistulosus*	Cucurbitaceae	fruit
2	Arrowroot	Arrowroot plant	*Maranta arundinacea*	Marantaceae	fruit
3	Ash gourd	Petha	*Benincasa hispida*	Cucurbitaceae	fruit
4	Beet root	Beta valgaris	*Beta vulgaris*	Chinopodiaceae	root
5	Bitter gourd	Karela	*Momordica charantia*	Cucurbitaceae	fruit
6	Bottle gourd	Calabash lau	*Lagenaria siceraria*	Cucurbitaceae	fruit
7	Brinjal	Began	*Solanum melongena*	Solanaceae	fruit
8	Broad beans	Fabaceae	*Vicia fba*	Fabaceae	fruit
9	Cabbage	Bandha goobi	*Brassica oleracea*	Cruciferae	leaf
10	Capsicum	Simlamirch	*Capsicum annuum*	Solanaceae	fruit
11	Cauliflower	Phool Gobhi	*Brassica oleracea*	Crucifere	flower
12	Cluster bean	Gwaar fali	*Cyamopsis tetragonoloba*	Leguminoceae	fruit
13	Colocassia	Colocasia	*Colocasia esculent*	Araceae	stem
14	Cow pea	Blackeye peas	*Vigna sinensis*	Leguminoceae	fruit
15	cucumber	Kheera	*Kukumis sativus*	Cucurbitaceae	fruit
16	Drumstick	Olifera	*Moringa oleifera*	Moringaceae	fruit, leaf
17	Fava bean	Sem phalee	*Vicia faba*	Fabaceae	fruit
18	Lady finger	Bhindee	*Abelmoschus esculentus*	Malvaceae	fruit
19	Pointed gourd	Putal	*Trichosanthes dioica*	Cucurbitaceae	fruit
20	Pumpkin	Cucurbita	*Cucurbita mosacchata*	Cucurbitaceae	fruit, leaves, flower
21	Radish	Moolee	*Raphanus sativus*	Crucifreae	root, leaves
22	Snake gourd	Chichinda	*Tricosanthes cucumeri*	Cucurbitaceae	fruit
23	Spine gourd	Spin ground	*Momordica dioica*	Cucurbitaceae	fruit
24	Sugar beet	Beet	*Beta vulgaris*	Amaranthaceae	root
25	Sweet potato	Shakar kand	*Ipomoea batatas*	Convulvulaceae	root
26	Tomato	Tamatar	*Solanum lycopersicum*	Solanaceae	fruit

Tables 2: Diversity of fruits cultivation on rooftop farm.

S. No	Fruit cultivation	Local Name	Botanical name	Family	parts use
1	Banana	Kela	*Memusa acuminata*	Musaceae	fruit,spathi,leaves
2	Citrus	Lembu	*Citrus reticulate*	Rutaceae	fruit,laeves
3	Grapes	Angur	*Vitis vinifera*	Vitaceae	fruit
4	Guava	Amrut	*Psidium gujava*	Myrtle	fruit,leave
5	Gooseberry	Gooseberry	*Phyllanthus emblica*	Phyllantheceae	fruit
6	Mango	Amba	*Mangifera indica*	Anacardiaceae	fruit
7	Litchi	Lichu	*Litachi chinesis*	Sapindaceaee	fruit
8	Maize	Maka	*Zea mays*	Poaceae	fruit
9	Pineapple	Sapuri	*Ananas comosus*	Bromeliaceae	fruit
10	Orange	Santara	*Citrus cinensis*	Rutaceae	fruit
11	Strawberry	Strawberry	*Fragaria ananassa*	Rosaceae	fruit
12	Water melon	Tarabhuja	*Citrullus lantatus*	Cucurbitaceae	fruit
13	Custard apple	Atta	*Annona squamosa*	Annonaceae	fruit
14	papaya	Bhanda	*Carica papaya*	Caricaceae	fruit

Table 3 : Diversity of green vegetables cultivation on rooftop Farms.

S. No	Leafy vegetables	Local Name	Botanical Name	Family	parts use
1	Ammaranthus	Pickly amaranth	*Amarantha viridis*	Amaranthaceae	green leaf
2	celery	Apiales	*Apium graveolens*	Umbeliferae	fruit
3	Celycon spinach	Basella lab	*Malabar spinach*	Basellaceae	leaf
4	Curry leaf	Kadhi pattam	*Murraya Koenigii*	Rutaceae	leaf
5	Green mustard	Black muster seed	*Barassica juncea*	Brassicaceae	fruit,leaf
6	Fenugreek leaf	Hari methi	*Trigonela foenum*	Leguminoceae	fruit
7	Mint	Lamiaceae	*Mentha*	Lamiaceae	fruit
8	Green onion	Onion	*Spring onion*	Amaryllidaceae	fruit,leaf
9	Coriander leaf	Dhania	*Coriander sativum*	Apiaceae	leaf,fruit
10	Mustard green	Brassica juncea	*Brassica juncea*	Brassicaceae	leaf
11	Spinach	Palak	*Spinacia oleracea*	Chinopodiaceae	green leaf

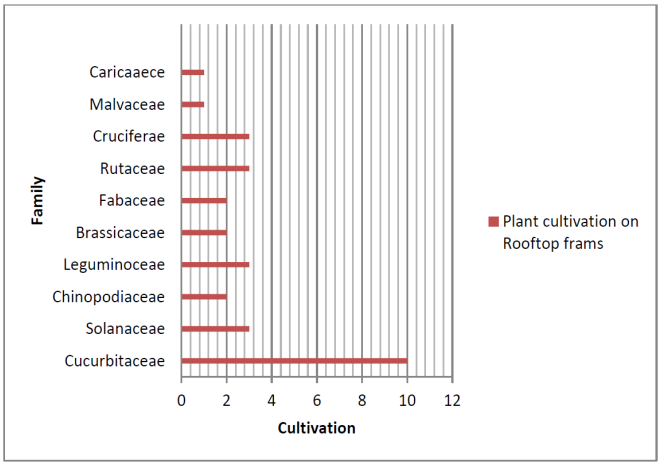

Fig. 8 : Plants cultivation with Family on rooftop farms

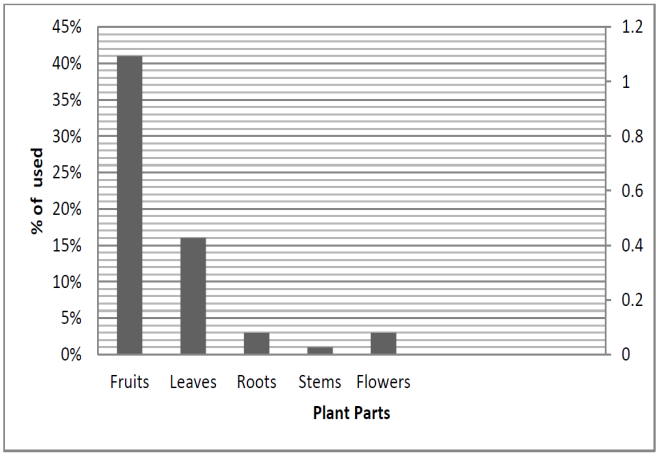

Fig. 9 : plant part used on rooftop Farms

Table 4 : Rate of Vegetable production on Rooftop farms

S. No	Vegetables	Production/ (Kg) /Plants	Price /Kg	Cost(Rs)	Benefit (Rs)
1	Tomato	4.2	40	12	168
2	Lady finger	1.5	40	6	60
3	Eggplant	3.6	30	9	189
4	Cauliflower	1.3	60	10	78
5	Cabbage	2.6	30	8	78
6	Pumkin	20.3	30	22	609
7	Cucumber	2.4	30	13	612
8	Radish	5.5/Grow bag	40	43	220
9	Bitter gourd	1.2	50	14	60
10	Ivy Gourd	4.3	40	19	172

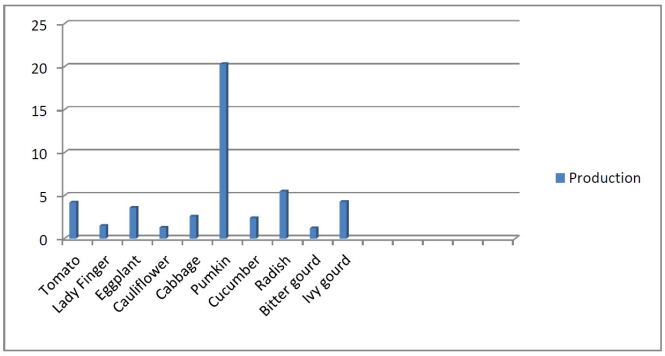

Fig. 10 : Vegetables Production on Rooftop Farming

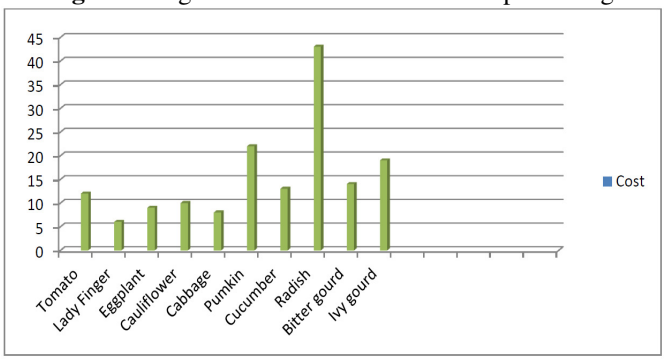

Fig. 11 : Cost per plant cultivation on Rooftop Farming.

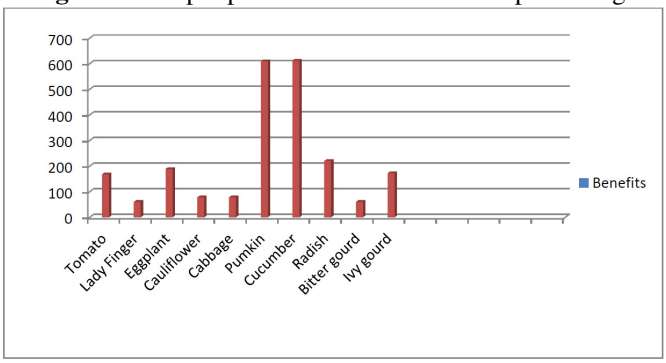

Fig. 12 : Benefits per plants cultivation on Rooftop Farms

Table 5 : Garden with production of food.

S. No	Gardens	Production ton/ annum
1	Rooftop	306.451
2	Terrace	128.844
3	Balcony	108.137
4	Baricade	68.142
5	Containers	45.128
6	Soilless	16.145
7	Kichen garden on Ground	867.286

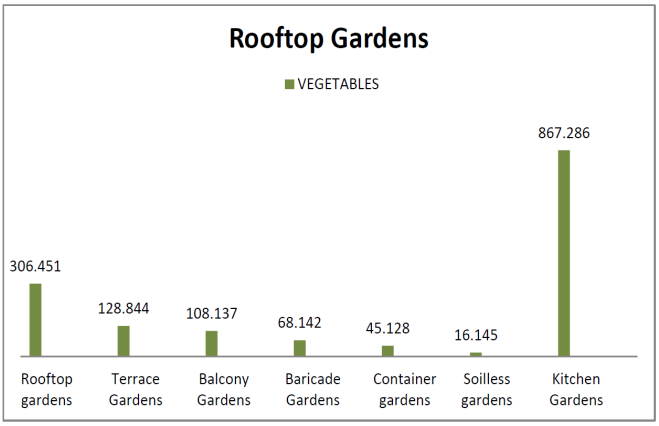

Fig. 13 : Production of vegetable in different rooftop garden

Yielding a variety of vegetables cultivated in rooftop farming for better production and short duration. Such identical vegetables are as follows in Table-5. The vegetables are cultivated in different high yielding varieties for better production in different seasons. The food production is carried out in building as rooftop farming highest production of food of rooftop gardens joust below the kitchen gardens (306.451 tons/year) and other 128.844, 108.137, 68.142, 45.128, 16.145, 86.286 in Terrace gardens, Balcony gardens, Barricade gardens, Container gardens, Soilless garden, Kitchen gardens respectively, Figure 9.

Table 6 : Numbers plants cultivation on rooftop farms.

S. No	Plants Cultivation	Numbers of plants cultivation
1	Vegetables	54
2	Flowers	48
3	Fruits	16
4	Green Vegetables	11
5	Cereals	2
6	Pulses	3
7	Legumes	5
8	Nuts	1

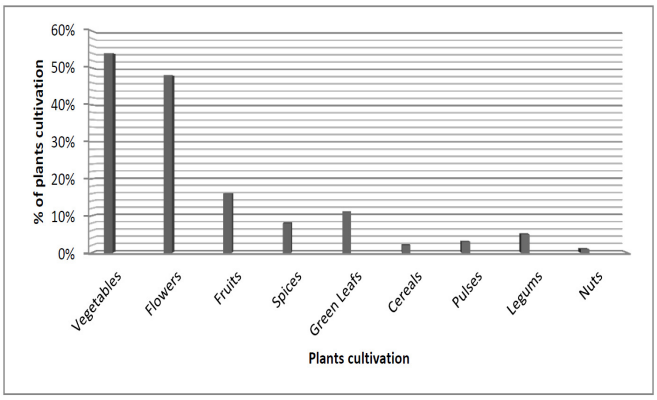

Fig. 14 : % of plants cultivation on rooftop farms

The food production on rooftop gardens is commonly vegetables. fruits ,spice, leafy vegetable, cereals, pulses, legumes, nuts in different ratio in Bhubaneswar "Figure-1". It is recorded as following percentage the highest production of vegetables 54%,fruits comprise to 16%, Leaf vegetables 11%and spices are Coriander, Garlic, Zinger. Onion. Garlic, Chilli etc only 08% cultivated in Rooftop farming in Bhubaneswar, Figure-8. Other plants like cereals, pulses legumes and nuts are cultivated in very less in comparison to others, Table-4.

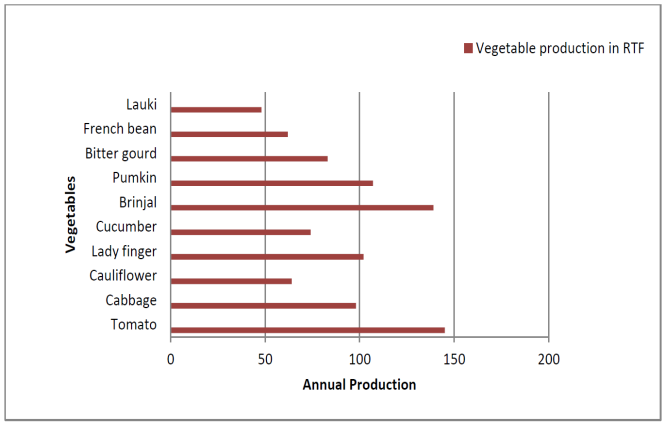

Fig. 15 : Field survey statistical analysis of annual production of vegetables Rooftop Farming in Bhubaneswar (ton/year).

In a field survey of 10 Rooftop farms in Bhubaneswar data given for growing important vegetables are produced following vegetables in tons per year, Figure 10. The food security of rooftop farming in urban areas has different Characteristics in Bhubaneswar such as proper nutrients, sufficient food in small spaces, food available on the doorstep of buildings, chemical free Organic food, fresh and tasty food, diversity of food. Vegetarian food is very attractive with good nutrient value. Quality food is gained on rooftop farming, Figure 11.

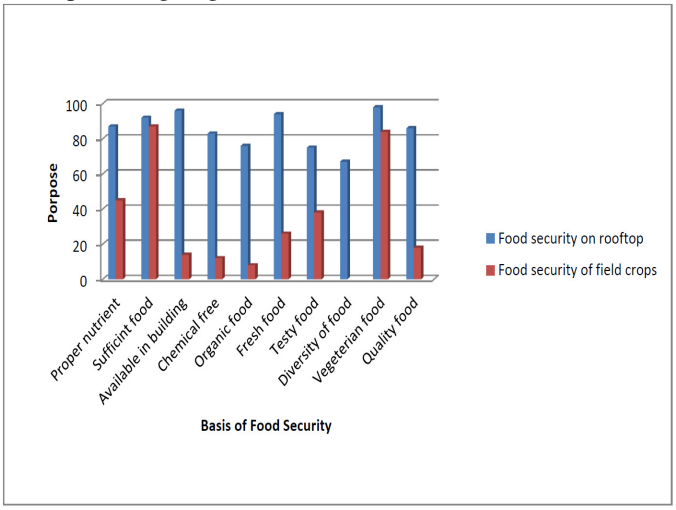

Fig. 16 : Statistical analysis for food security concept from Rooftop Farming and field crops

As per a field survey of 10 rooftop gardens, kitchen gardens, Farmhouses and vegetable markets respectively, of urban and peri-urban areas of Bhubaneswar, it is the result that finally the food security is provided in different sources on the basis of cultivation on different cultivated areas. These generally are 96 % of food security on Roof top because foods are getting their own roof and guidance. Household kitchen gardens provide about 86% of security due to organic foods being yielded. Use of chemical fertilizers and pesticides in other farmhouses gives us moderately less than 45% of food security. The food from vegetable markets provides 24% only food security and it is very less Figure 12. In This regard rooftop farming has highest economical value of food security.

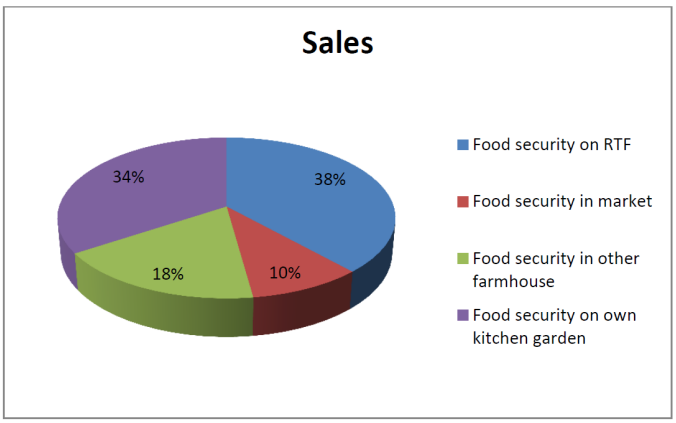

Fig. 17 : Food security of various sources in Bhubaneswar city.

Discussion

Vegetables production on rooftop farming is a new concept of food security. Rooftop farming is a landless urban farming that grows various types of vegetables, fruits, flowers, spices and ornamental plants. It is one of the household farming sustain food security because of food value. The most important vegetables are grows on rooftop farming are tomato, beans, gourds, eggplants, cauliflowers, cabbages, lady fingers, pumpkins, radish, Drumstick and capsicum in different high yielding variety. The fruits are also cultivated such as papaya, lemon, mango, strawberry etc. Further the spices are also cultivated as coriander, garlic, onion, ginger, turmeric also varieties of leafy vegetables are cultivated on the rooftop farming. All the foods are cultivated in containers, grow bags and by lawn. The use of compost, vermi compost, amritsar (a types of liquid media made up of cow urine and molasses) and soilless compost by coco peat instead of soil and chemical fertilizers by the result of organic foods are grown on the rooftop farming. In rooftop farming obtains fresh tasty foods, Chemical free foods, quality foods, organic foods. Therefore food security is more than other foods that refer to future enhanced food security and economical sustainability of Bhubaneswar.

Conclusion

The plants are cultivated on RTF is very useful for urban people. It provides food security, economic value, Ecological benefits etc. The cultivation of vegetable, foods, spices and medicinal plants enhance the food security. It meets to daily needs for food. Fresh organic foods are obtained from door step on the rooftop farms. In vegetables cucurbitaceae family is cultivated more on rooftop farms. Fruits are the highest plant part uses for food come from rooftop farms that are 54 types. Leafy vegetables are 11 types. Best production of vegetables plants are pumkin, cucumber, tomato, brinjal, Bitter gourd etc. The highest benefited vegetables are cultivating on rooftop farms are pumkin, cucumber, cauliflower and radish. Food security is important for human health strategy. 80% of foods are contaminated by the uncontrolled use of chemical fertilizers and pesticides. It is suffered from health hazard and Create Chronic diseases like diabetes, high blood pressure, high level of cholesterol create heart disease. So we need fresh and healthy food. Contaminated food looses their quality and nutritive value. Food from rooftop farming sustains the food quality as well as nutritive value due to grow organic vegetables. All most all the vegetables can grow in rooftop farming in equal quantity 45%. High yielding vegetables are growing on rooftop farming for profit making and provide food security (96%). Household farming like as rooftop garden, Terrace gardens, balcony gardens produce high range of organic food. Food security on RTF 38% and the kitchen garden 34%.the food security are very less from market food i.e. 10%. On the basis of food production and maintenance of food quality, quantity, nutrient value rooftop farming is giving us food security. On the other hand, rooftop farming grows organic, fresh and tasty food. This opportunity from rooftop farming meet to food security to urban people Bhubaneswar a smart city of India.

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