

DEVELOPING COMMUNITY GARDENS AND MANAGING THE MODMESTIC ORGANIC WASTE CASE STUDY: SULTANABAD, KARACHI

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ABSTRACT

One of the most important dilemmas of the growing city of Karachi is access to green spaces for a large majority of the population. Over-crowding and congestion has made it hard for the common people to connect with open spaces, gardens and landscape areas. As a result, they are unable to resolve their health, nutrition and hygiene issues.

This study considers the various options for community greening in the developing world. More particularly, Karachi is focused for managing and promoting community betterment, health and hygiene through community-level organic farming. Sultanabad and Hijrat Colony, two low-income neighborhoods in Karachi, have been used as case studies to enable an analysis of the problems of community greening and composting and its solutions.

The aim of this study was to explore the practice of community-level composting out of organic waste, along with urban gardening in the developing world through a case study methodology. A review of narrative literature and a live project at Sultanabad was conducted consecutively in order to achieve this.

The literature review revealed that community-level composting combined with urban gardening is the most effective and valuable technique available for the management of organic waste. Furthermore, it was found that this technique could play a positive role in terms of easing the financial and administrative burden on municipalities as well as building of community income resources. Ultimately, this would not only save money for the low income groups, rather it would generate a source of income for them. The case study, however, revealed a number of threats to composting and urban gardening including: illiteracy, water shortage, extreme weather events, an unregulated waste economy and land unavailability. This study argues that

community-level composting and community gardening is an important means of generating food and income within the communities of Karachi.

Keywords: Community gardens, community-level composting, organic waste management

INTRODUCTION

A proposal has been conceived in this paper to create 'space' for a community where open green spaces, in terms of environmental improvement and improvement of household health and hygiene, would be promoted and implemented practically. The generated spaces and activities can promote greater harmony and bonding among the residing communities.

Precisely, community vegetable gardens and kitchen gardens in the urban context of Karachi for low income group could help initiate the idea of connecting them with the earth and cultivate / grow on their own land. The main idea is to ensure that communities and users are provided with sufficient awareness and given land possessions to grow on their own land.

A vegetable garden benefits from growing vegetables and other useful plants for human consumption. Gardening is a great way to make productive involvement of a family and the overall community to create unity among its member and to overcome the food crisis, low earnings and inflation. The proposed project is considered to initiate social mobilization and community work to ensure spread of the project benefits to the entire locality and add sustainability component to the intervention. This would be inculcating 'values' of selfless help and positive community bonding in their future generations to provide long term sustainability to the initiated intervention. Also a 'culture' of community self-help and viable models of community-government

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interaction for civic improvements would be established.

WASTE MANAGEMENT SYSTEM IN KARACHI

Karachi's rubbish laden streets confirm that one of the most neglected services is solid waste management (Ali and Hasan, 2004). Furthermore, the lack of green spaces confirms the negligence of flora and fauna in the city's landscape.

The waste management sector in Karachi has developed into a complex economic system in its own way. In 2001 the recycling industry was providing employment to 55,000 families and had an annual turnover of 1.2 billion Pakistani rupees (PKR) (600,000 USD), and these figures are likely to be significantly greater today (Ali and Hasan, 2004). Three thousand waste pickers and their families live and work in Jam Chakro landfill site alone (CDGK, 2007).

The solid waste management has been accorded low priority by the government of Pakistan, and in particular by the government of Karachi (Ali and Hasan, 2004). Every proposal for the improvement of the waste management system put forward by various groups was either not implemented at all or once started was not completed, despite the projects

being feasible. The reason most commonly cited for failure was the lack of government interest and support (CDGK, 2007). The four most significant of these proposals are summarized in Table 1.

From the failure of the proposals given by the various groups of experts the following can be deduced:

- There are inadequate funds: The system is heavily reliant on aid in the form of grants and loans (CDGK, 2007). Budget allocations are also inadequate and inappropriate. There is very little capital expenditure as the majority of the total budget is spent on maintenance costs (Ahmed, 2009).
- The existing transportation facilities are inadequate and inappropriate (CDGK, 2007). Refuse vehicles currently make two to three journeys to a dump site every day, sometimes covering sixty kilometers despite many areas still receiving no waste collection service at all (CDGK, 2007).
- There is a significant shortage of employed staff. For example, there are 1.06 sweepers for every one thousand people. Furthermore, the existing staff are poorly trained (CDGK, 2007).

Table 1: Past proposals for the improvement of the waste management system

YEAR	PROPOSER	PROPOSAL TITLE	SUMMARY
1980	Farooq Ahmed Saleem	Farooq Compost Fertiliser Corporation Plant	Proposal to convert one thousand tonnes per day of organic waste into compost in a large composting facility on the outskirts of the city (Ahmed and Zurbrugg, 2002)
1994	NED University of Engineering and Technology, Karachi	The Garbage Train Project	Proposal to integrate the inner circular railway system into the existing truck based waste transport system to improve the transfer of waste to the landfill site, as well as the upgrading of the city dumpsite into a sanitary landfill site (Anwar, 2000)
2001	NED University of Engineering and Technology, Karachi	Eco-scavenging: an environmentally friendly manual	Proposal that all recycling activities should be moved to the city's two official landfill sites and that concrete scavenging platforms should be constructed at the sites for waste separation in order to increase efficiency as well as to make the job more dignified
2001	Urban Resource Centre, Karachi: Mansoor Ali, Arif Hasan	Integrated recycling and disposal system for solid waste management in Karachi	Proposal that all recycling activities should be conducted in the city's two official landfill sites and all waste pickers be relocated to the landfill sites where they would be provided with land, housing, electricity and basic sanitation services (Ali and Hasan, 2004)

- The government staff managing the system lack technical and managerial skills.
- The data available on the quantity and consistency of the waste generated in Karachi is outdated and inaccurate (Ali and Hasan, 2001). ‘Mechanisms for citizens’ participation, consultation and dialogue are extremely limited and are mostly restricted to the practice of registration of complaints and their subsequent follow-up. Channels for meaningful communication with civic officials and active citizens’ involvement in the affairs of the civic bodies do not exist’ (Ali and Hasan, 2004: 7).
- Low-income areas, including slums, are not provided with a waste collection service by the government. ‘Middle-

and upper-income settlements receive a higher priority due to overall political influence and clout in urban affairs’ (Ahmed, 2009: 171).

- There is lack of awareness among citizens and communities regarding the importance of proper waste management (Ahmed, 2009).

COMPOSTING AND URBAN GARDENING IN KARACHI

The situation of composting and urban gardening in Karachi is reviewed with regards to the five aspects put forward by Cofie, et. al. (2006) that are described in Table 2. In addition, examples of composting and urban gardening activities

Table 2: Feasibility of composting and urban gardening in Karachi
Source: CDGK, 2007; Khalid, 2005

Supply	Demand	Institutional, legal and communal framework	Economics	Processing
<ul style="list-style-type: none"> • Organic waste in Karachi: food waste, abattoir waste, agricultural and garden waste, human and animal waste, agro-industrial waste • Sources of organic waste in Karachi: Households, vegetable market, fish market, wood market, gardens, Eid-ul-Adha (annual holy festival), slaughter houses, agriculture, restaurants and hotels, food industries, sewage treatment plants • Over 50% of Karachi’s total waste is organic which totals to over 5000 tonnes • Organic waste is currently disposed off along with other waste streams, including hospital waste, resulting in contamination • Organic waste currently has no market value in Karachi 	<ul style="list-style-type: none"> • Pakistan = agricultural country- 100,000 tonnes of fertilizer shortage by 2004 • Studies of citizens’ perceptions of composting/ demand for compost/ willingness to pay for compost are needed • Composting is practiced in homes and has previously been tried at city level indicating composting may be culturally acceptable 	<ul style="list-style-type: none"> • Laws and regulations are outdated and none specifically relate to composting • No constraining or supportive government policies are present • Composting is now mentioned in the government’s ‘Karachi Strategic Development Plan 2020’, but no plan for its implementation is suggested. The document just says composting is a ‘long term goal’ but in the interim organic waste will be land-filled • Constraint – land availability • The current government system is non-participatory 	<ul style="list-style-type: none"> • Total cost of implementation must be calculated for the specific system introduced • Economic benefits: provision of jobs, revenue generation through sale of compost, savings through access to fruit/vegetables 	<ul style="list-style-type: none"> • Data in this area is lacking – feasibility study needed • Composting capacity required: 4000-5000 tonnes

currently taking place in Karachi are explored on the basis of these categorizations.

Although urban organic waste is generally poorly managed in Karachi, there are a number of examples of composting and urban gardening taking place in this metropolis city. Composting and urban gardening activities are practiced on different scales and are organized in a variety of ways (figure 1). These activities are poorly documented so can only be briefly summarized as opposed to discussion in depth.

Individual Level

Although no official survey has been conducted into the number of households practicing composting in Karachi, there is evidence to suggest that households are using their organic waste to produce compost, and the number of households doing so is rising. Composting is however predominately carried out within middle- and high-income households due to their increased environmental awareness through education, combined with the fact that they have the time and resources to invest in composting. Furthermore, these individuals and families often have a garden where they grow ornamental and increasingly edible plants and therefore they have a use for the compost they produce (Sehri, 2013) (figure 2). Low-income households however, seldom practice composting for a number of reasons: their biggest concern is often where the money is going to come from to feed their families, so the environment is not a prime concern; there is often no space for a garden, leading these households to believe that they have no use for compost; or they simply lack awareness and have little or no knowledge

of composting (Sehri, 2013).

A small number of socially and environmentally conscious high-income individuals also purchase plots of land for the development of model gardens or farms in which composting is practiced and used to fertilize the soil, as opposed to chemical fertilizers. These individuals allow interested community members to visit their gardens and even participate in the gardening (Sehri, 2013).

Community Level

One important community level initiative is the development of a 'Guerrilla Gardening' group. Guerrilla Gardening refers to gardening on a piece of land without permission. This began when a group of individuals from a middle- to high-income locality were refused permission to develop a community garden on an unused plot of land in their neighborhood that was officially designated as space for a public park. The group transformed a barren island in the middle of the road adjacent to the plot into a vegetable garden, using the compost produced within their own homes and water from their houses, which they carried to the area in wheelbarrows. The leader of the Guerrilla Gardening Project explained that they wanted to provide food for poor passersbys, raise awareness about organic vegetable gardening, bring their community together and show the authorities that a community garden could work in Karachi.

In addition, a community of gardening enthusiasts in Karachi, predominantly high-income women, joined to form Karachi

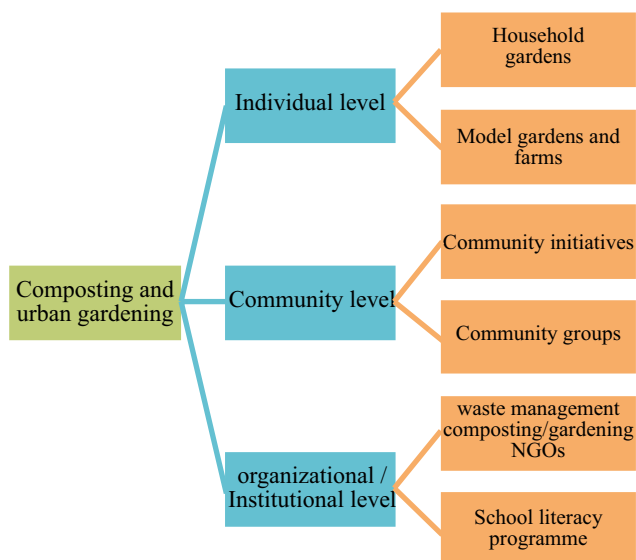


Figure 1: Composting and urban gardening in Karachi
Source: Categorizations by Author in 2014



Figure 2: Rooftop gardening and composting in a high-income household

Amateur Gardeners Club (KAGC). The group holds regular meetings where members give talks about various topics, such as composting, water conservation and the making of seed bombs, in order to help educate themselves and teach each other. In addition, they hold an annual food festival. They also have an active webpage through which they try to raise awareness through sharing gardening advice, particularly on environmentally friendly gardening practices, and share pictures of their flowers, vegetables and gardens (figure 3) (KAGC, 2013).

Organizational Level

A number of Karachi based NGOs work on promoting composting and urban farming. Gul Bahao, whose focus is waste management, has been making compost for years using urban organic waste. In 2013, the NGO launched a new project called 'hawai khet' (gardens in the air) where they created structures from scaffolding from which they hung discarded bags filled with compost to grow vegetables. This was done to create a spectacle for display at Pakistan's first Environment Museum in order to stimulate thought and raise awareness about what can be done with waste (figure 4) (GulBahao, 2013).

Another NGO, Crops in Pots, aims to show those individuals who do not have a large garden space that they too can have a garden to grow organic food. They hold workshops to teach people about composting and the development of pot gardens, as well as set up these gardens for individual households and company buildings. They have an active webpage where they post thought provoking pictures to raise awareness, promote the work of others in this field, as well as display their own work (figure 5).

Crops in pots have also launched a school literacy programme where they educate school children about the importance of composting and urban agriculture. They also teach children how to develop a compost pile and garden in their own homes.

ANALYSIS AND DISCUSSION REGARDING COMPOSTING AND URBAN GARDENING IN KARACHI

The situation analysis of Karachi and its waste management system revealed a number of difficulties faced by the city. These difficulties however, as the literature review demonstrated, can all be addressed in some way by composting combined with urban gardening. It is a fact that composting can contribute to solving a number of Karachi's difficulties, in a relatively inexpensive way; which justifies



Figure 3: KAGC meeting and talk on growing watermelons at KAGC food festival
Source: KAGC, 2013



Figure 4: Hawaii Khet
Source: Gul Bahao, 2013



Figure 5: Bonsai making and lime harvest from a pot garden set up by crops in pots
Source: Crops in Pots, 2013

its implementation in the city. These difficulties and the way in which composting can address them are taken from the situation analysis and the literature review respectively, and summarized in Table 3.

In order to look into the possibility of composting and urban gardening for Karachi a SWOT analysis was undertaken and is presented in Table 4.

The SWOT analysis reveals several positives that could contribute to the successful implementation of a composting and urban agriculture programme in Karachi. The most significant opportunity highlighted is the fact that the city

Table 3: Justification for composting and urban gardening in Karachi

Problems Related to Composting in Karachi	How Composting Can Contribute to Solving the Problem
Poor waste management (Ali and Hasan 2001)	Composting would help take organic waste off the streets, divert waste from landfill and kill pathogens present in the waste. By reducing the waste volume it would allow the existing system to improve its service for collection and management of non-organic waste and expand to areas of the city that are currently not serviced (Slater and Frederick, 2001)
Declining green spaces (Qureshi Kazmi and Breuste 2010)	Compost production would promote urban agriculture and therefore an increase in green spaces: gardening at household level community gardening school gardens and public parks planting along roadsides (Grim, 2012)
Law and order	Composting and practicing urban agriculture would bring communities out of their homes and on to the streets and facilitate social interaction both of which will lead to a reduction in crime (Kuo and Sullivan, 2001)
Ethnic violence (Mukhtar, 2007)	Composting and practicing urban agriculture would facilitate interaction between different ethnic groups and provide them with a common goal and could decrease friction between communities (Smith and Bailey, 2006)
Poor transport system (Hasan, 1999)	Composting has the potential to reduce the burden on the waste transport system by half therefore reduce trucks on roads depending on the type of system implemented (Zurbrugg et al, 2005)
Poverty (Mukhtar, 2007)	Composting would provide jobs and compost to sell. Through making free/cheap food available urban agriculture would allow savings and investment in other areas therefore help to break the poverty cycle
Inequality (CDGK, 2007)	Composting combined with urban agriculture could improve access to nutritious food for all therefore would contribute to food security and equality (Grim, 2013)
Climate change (Anwar, 2012)	Composting reduces methane gas emissions from landfill sites and may reduce carbon dioxide emissions from transport (Eionet, 2012)

Table 4: SWOT analysis for composting and urban gardening in Karachi

Strengths	Climate of Karachi – an expensive closed system would not be required to maintain the right conditions for composting as the normal outdoor conditions are ideal (Average annual: temperature= 25.9°C, precipitation= 203mm, humidity= 70% (Anwar, 2012) Availability of man power Composting is culturally acceptable (GulBahao, 2013; Crops in Pots, 2013) Developed and active civil society (Anwar, 2000)
Weaknesses	Previous attempts to improve the waste management system, including plans for one composting plant, have failed (Ahmed and Zurbrugg, 2002) Karachi's authorities lack finances (CDGK, 2007) Legislation is lacking and outdated Karachi's governance system is not participatory (Khalid, 2005) Data in the waste management field is lacking and outdated (Ali and Hasan, 2004) The population lacks awareness of climate change, sustainability and the environment (Ahmed, 2000)
Opportunities	Large supply of organic waste – it is a resource that just needs to be realized (CDGK, 2007) Demand for compost – Pakistan is an agricultural country lacking in fertilizer, plus it is wanted by the population and already carried out in households and by NGOs (Anwar, 2012) Composting provides an economic opportunity in the form of jobs and saleable compost – this needs to be realized External funding is available for sustainable, environmentally friendly projects CDGK has suggested composting as a 'long term' solution to the waste management problem in Karachi, the government is therefore displaying an interest in composting (CDGK, 2007)
Threats	Water shortage (Anwar, 2012) Extreme weather events – Heavy rainfall and flooding (Anwar, 2012) Unregulated waste economy Land unavailability (Hassan, 1999)

government has expressed an interest in composting because, as explained earlier, the primary reason for the failure of the previous attempt at composting, as well as other attempts to improve the waste management system, was the lack of government interest and support (CDGK, 2007).

ONGOING DEBATE IN KARACHI: CITY-LEVEL (CENTRALIZED) COMPOSTING VERSUS COMMUNITY-LEVEL (DECENTRALIZED) COMPOSTING

The above discussion demonstrates the relevance of the centralized versus decentralized composting for Karachi. This debate therefore needs to be studied in more depth. The literature revealed several requirements for the successful implementation of a city-level composting system (Table 5).

Karachi potentially has the land for city-level composting, the city is unable to meet the other requirements like a strong political will, funding and transport facilities, so a city-level composting plant has great potential to fail. A community-level composting system on the other hand does not require the same level of government involvement or funding and it is less reliant on the transport system (Grim, 2013). Therefore considering Karachi's poorly functioning and overburdened municipal authorities, lack of funding and inefficient transport system, a community-level composting system is more likely to be implemented successfully if land can be secured. However, as was explained earlier, the issue of land availability is a serious one, and the success of a community led composting system is dependent on it.

Table 6 looks at the list of difficulties Karachi is facing, deduced from the situation analysis. The table also analysis

Table 5: Requirements for a successful city-level composting system and Karachi capacity to meet these requirements

REQUIREMENT FOR CITY LEVEL COMPOSTING	KARACHI	
Government/ municipal involvement (Ahmed and Zurbrugg, 2002)	Lack of political will to manage the urban waste problem. Other issues take precedence e.g. law and order. The current waste management system is poorly managed. The government has failed to support a previous attempt at composting.	X
Sufficient funding (Rothenberger, 2007)	Inadequate funding (CDGK, 2007)	X
An efficient waste transport system (Sehri, 2013)	Transport facilities are inappropriate and inadequate (CDGK, 2007) Truck drivers are often bribed into inappropriate dumping of waste	X
Availability of Land (Cofie, et. al., 2006)	The government owns land on which a central composting facility could be set up (CDGK, 2007)	✓

Table 6: Problems of composting in Karachi and appropriate composting system for the city.

PROBLEM IN KARACHI		CITY-LEVEL COMPOSTING SYSTEM	COMMUNITY LEVEL COMPOSTING SYSTEM
Poor waste management	✓		✓
Declining green spaces	✓	Depends on what the compost is used for, most likely given to the highest bidder so won't increase public green spaces	✓
Law and order	X	No effect as centralized composting does not allow for community involvement (Grim, 2013)	✓
Ethnic violence	X	No effect as centralized composting does not allow for community involvement (Grim, 2013)	✓
Poor transport system	X	Would burden the transport system more as the compost produced would require redistribution (Rothenberger, 2007)	✓
Poverty	X	Little effect – a city-level composting plant in Karachi would only provide employment for 15-20 people and sale of the compost would benefit the municipality (Khalid, 2005)	✓
Inequality	X	No effect – would not improve access to nutritious food	✓
Climate Change	✓		✓

these problems that could be addressed by the implementation of either the city-level or community-level composting system. Where the composting system could fail to address a problem, an explanation is given in the table as to why this could be so.

CASE STUDY

Field work was done within the region of Karachi. The main purpose of this field work was to review and manifest a proper system of urban gardening in Karachi. In order to do this however, the context in which the communal based composting and urban gardening had to be managed is initially explained.

Description of the Practical Field Work

A community based program was initiated named ‘Sustainable Sultanabad’, in Sultanabad, where after a preliminary process of survey and evaluation of community neighborhood, few local people were selected and trained. The program focused on environmental improvement through organic urban farming and kitchen gardening, linked with composting and health and hygiene awareness, with an accompanying vision and plan for long term sustainability based on promotion of ‘community self help’ models. A scheme had been visualized in the “Learning Garden Workshop” in a public school to educate the new generation about nature appreciation, environmental sustainability and aesthetics and to develop a sense of cleaning their surrounding and to grow food in their homes and other available spaces around them. Secondly, another “DIY Vertical Garden Workshop” was planned to create ‘space’ for a community where open green spaces in terms of environmental improvement and household health and hygiene were to be promoted and implemented.

The objective was to promote greater harmony and bonding among the residing communities and initiate and sustain the volunteers, who would eventually take the role of ‘facilitators’ from ‘implementers’ and the communities will take the lead role in the various aspects of the project.

Educating the new generation at school about the methods of planting various edibles at micro level aimed to teach the benefits of urban farming in terms of health and resulting environment. Furthermore, the community vegetable gardens and kitchen gardens in the urban context of Karachi aimed for low income groups to connect with the earth and cultivate pieces of land. The main idea was to ensure that communities and users within the selected vicinity were provided with

sufficient awareness and had the opportunity to grow food for themselves.

The proposed project aimed to inculcate ‘values’ of selfless help and positive community bonding in the future generations. Also a ‘culture’ of community self-help and viable models of community-government interaction for civic improvements were aimed to be established.

The concept of educating the new generation to turn open and abandoned spaces into edible gardens and the greening of low-income neighborhood and its public school as a promotion of urban gardening in the urban context was developed as a response to the deprivation of such open green spaces for the local common people living in congested and unplanned areas of the city.

Location of the Case Study Area

Sultanabad is a low income area in Karachi located on the southern edge (Figure 6).

Learning Garden Sessions at the Public School in Sultanabad

A green curriculum had been visualized in the “learning garden sessions” for a public school in Sultanabad to generate awareness and educate the new generation. In this scheme of studies, the volunteers and experts taught the female students of grades six to eight about nature appreciation for promoting environmental sustainability, aesthetics, to develop a sense of cleaning their surrounding and of growing edible plants in their homes and other available spaces around them. The students were also encouraged to spread the given knowledge further to their families, friends and communities.

The program visualized generating awareness of the importance of environment, green spaces and growing plants at an early stage of secondary education level through an



Figure 6: Map showing the area of Sultanabad, Karachi

additional course / extracurricular activity. The course entitled “learning garden” included art work and physical implementation of planting and composting methods. Female Students were chosen to acquire this additional course keeping in view the interest and understandability of the students coming from background of the villages and informal sectors. Since this type of courses are hardly being offered in schools of Karachi, therefore, such awareness was thought to be essential, as it may be easily learned, transferred and spread by female children to friends, families and other groups.

The course was carried out through various sessions taught step by step in extra-curricular classes, which was completed in a duration of two months. These sessions had diverse topics which were delivered to the students in Sultanabad, is (Tables 7 - 8) (Figures 7 - 8).

The first session started with the introduction on the universe as a whole environment and how one can help save the environment by doing small deeds. The topic was explained thoroughly with the help of general discussion and by giving examples of the daily routine so that the students get a clear idea of what they were being taught about.

At the end of the first session, a handout was given to all the students in order to make them memorize what was taught in the class. Furthermore, some brain storming that was required to be attempted in the handouts was explained through discussion.



Figure 7: Explanation and general discussion in the introductory session at school



Figure 8: Working on handouts and checking handouts given to the class

In the second session, handouts were read out loud for better understanding of the topic and to explain how to go about the learning process throughout the course.

In this session, the students were taught about the qualities of a good citizen and how could they become superior global citizens. All this was made clear through a well-prepared multi-media presentation. Later another set of handouts were distributed which the students were asked to complete on their own.

In the third session, the students were taught ways and means of tracking their waste. What waste they generated and how were they disposing it and what harm were they doing to the earth as a whole and ultimately to the global environment was discussed (Figure 9).

Table 7: The schedule of the Learning Garden Sessions conducted at a public school in Sultanabad, Karachi

DATE	TOPIC	SESSION	GRADES	TOTAL No. of STUDENTS
15 October '14	Nature Appreciation	1 st	6 & 7 & 8	100
16 October '14	Global Citizenship	2 nd	6 & 7 & 8	100
20 October '14	Tracking our Waste	3 rd	6 & 7 & 8	100
21 October '14	Tracking our Food	4 th	6 & 7 & 8	100
27 October '14	Learning Garden	5 th	6 & 7 & 8	100
28 October '14	Learning Garden	6 th	6 & 7 & 8	100
29 October '14	Tracking waste and separating trash	7 th	6 & 7 & 8	100
27 November '14	Learning Garden	8 th	6 & 7 & 8	100
28 November '14	Learning Garden	9 th	6 & 7 & 8	100
1 December '14	Learning Garden	10 th	6 & 7 & 8	100
2 December '14	Learning Garden	11 th	6 & 7 & 8	100
3 December '14	Composting	12 th	6 & 7 & 8	100

Table 8: The details of the activities conducted in the learning garden sessions at the public school in Sultanabad, Karachi

SESSION	TOPIC	ACTIVITY
1	Nature Appreciation	1. Introduction on the universe as a whole environment 2. Multi-media presentations 3. Handouts 4. Discussion
2	Global Citizenship	1. Reading and checking the given handout for better understanding 2. Multi-media presentations 3. Handouts 4. Discussion
3	Tracking our Waste	1. Reading and checking illustrations from the last given handout along with rewards for encouragement 2. Multi-media presentations 3. Handouts 4. Discussion
4	Tracking our Food	1. Reading and checking illustrations from the last given handout along with rewards for appreciation 2. In class activity work 3. Given chart papers, stationery, magazines, newspapers, etc. 4. Discussion
5	Learning Garden	1. The school terrace was occupied for the practical work 2. Given benches, pots (of various sizes), sacks of animal waste / soil, gardening tools, etc. 3. Students arrange the pots and mixed the appropriate compost 4. Demonstration and explanation
6	Learning Garden	1. Students were taught to sow seeds 2. Secondly they were demonstrated to plant stems like: mint and chards 3. Demonstration and explanation
7	Tracking waste and separating trash	1. The school campus clean up activity was done practically 2. Given sketchbooks, colors, stationery, etc. 3. Students were asked to map all floors and mark the garbage, wrappers and identify the type of litter 4. Demonstration and explanation
8	Composting	1. Given bins for each classrooms, corridors and open spaces 2. Students were taught to dispose waste properly 3. Demonstration and explanation
9	Composting	1. Given three big bins for the assembly area (open courtyard) 2. Each marked as tin and glass; Plastic bottles and bags; and compost. 3. Students were taught to separate waste as per the labeled Bins. 4. Compost material /item were taught in detail 5. Demonstration and explanation
10	Learning Garden	1. Students were taught transplant process 2. Demonstration and explanation
11	Learning Garden	1. Students learned to pick unwanted wild leaves that outgrow from compost 2. Demonstration and explanation
12	Add-on Composting / saving seeds	1. Students learned to add nutrients to compost by meshing banana peels with gur and later add in compost bin 2. They were taught to prepare seeds for sowing 3. Demonstration and explanation

In the next session, the school terrace was occupied for practical gardening work. The students were given benches, pots (of various sizes), sacks of animal waste / soil, gardening tools, etc. The students were asked to arrange the pots and mix the appropriate compost (figure 10). The session ended with an elaborative demonstration and explanation of the entire process of gardening.



Figure 9: Multimedia resentation to the class



Figure 10: Terrace of the school occupied for practical gardening sessions of sowing planting, transplanting and harvesting

In the next session the school campus clean up activity was undertaken. The students were given sketchbooks, colors, stationery and were asked to map all levels, mark garbage and identify the type of litter present at the school campus. After doing that they were more aware of the type of litter present on the campus and the dirty zones around them. It was explained to the students, how to manage and dispose of such small scale trash around their premises. In this learning they were also taught to avoid market based junk items and eat more healthy food brought in from homes and wrapped in good lunch boxes, so as to avoid too much polythene bags.

In further sessions on composting, the school was given three big bins for the assembly area (open courtyard), marked as tin and glass, plastic bottles and bags and compost. The students were taught to separate waste as per the labeled bins. In the concluding session, students learned to add nutrients to compost by meshing banana peels with *gur* and later adding it into the compost bin. They were also taught to prepare seeds for sowing in a practical gardening session. They were encouraged to apply whatever they had learned in their homes and around their community spaces.

VERTICAL GARDEN SESSIONS

A vertical gardening had been visualized in the “DIY Vertical Garden Workshop” for a particular community to generate awareness and educate the members. In this workshop, the volunteers and experts taught the lady members of the selected community about nature appreciation for promoting environmental sustainability and develop a sense of cleaning

and of growing food in their homes and other available spaces around them. They were also encouraged to spread the given knowledge further to their families, friends and communities.

The title of the workshop conducted in the selected community of Sultanabad was “Vertical Garden Program”. The program was intended to make females aware of the hygiene of the vegetables / fruits in the markets on first hand. The second intention was to make them practice fresh food growth without using polluted water and chemical sprays. Ultimately the target community was taught to track their own waste to produce clean and healthy soil (compost) for home grown food. The workshop included physical implementation of planting and composting methods. Women members of the community were selected to attend this workshop, keeping in view the interest of each individual coming from diverse backgrounds of informal sectors. Since this type of workshops are hardly available in Karachi, therefore, such awareness is essential as it can be easily imparted, transferred and spread by female and their families to other families and other group of people.

SCHEDULE FOR SESSIONS

The first session of the vertical garden workshop started with the introduction on the concept of vertical gardening and the knowledge of growing plant in less area (Tables 9 and 10). Vertical gardening is possibly the most space-efficient method of gardening today in the urban context. The expert made it sure that all members were well aware of what they were about to do. A detailed demonstration of

Table 9: The schedule of the Vertical Garden Sessions conducted at a community in Sultanabad, Karachi

DATE	TOPIC	SESSION	GROUP	TOTAL No. of STUDENTS
22 October '14	DIY Vertical Garden	1 st	A	30
23 October '14	DIY Vertical Garden	1 st	B	30
29 October '14	Sowing seeds and transplanting seedling	2 nd	A	30
30 October '14	Sowing seeds and transplanting seedling	2 nd	B	30
11 November '14	Growing herbs	3 rd	A	30
12 November '14	Growing herbs	3 rd	B	30
18 November '14	Composting at home	4 th	A	30
19 November '14	Composting at home	4 th	B	30
25 November '14	Making Natural Fertilizers	5 th	A	30
26 November '14	Making Natural Fertilizers	5 th	B	30
4 December '14	Saving Seeds	6 th	A	30
6 December '14	Saving Seeds	6 th	B	30
Mid December '14	Harvesting	7 th	A & B	60

Table 10: The details of the activities conducted in the Vertical Garden sessions at the community in Sultanabad, Karachi

SESSION	TOPIC	ACTIVITY
1	DIY Vertical Garden	<ol style="list-style-type: none"> 1. Introduction on the concept of vertical gardening and knowledge of growing plant in less area 2. Sample given for practical vertical kitchen garden 3. Detailed demonstration of method of using given sample and planting in it
2	Sowing seeds and transplanting seedlings	<ol style="list-style-type: none"> 1. Demonstration of sowing seeds and transplanting (with roots) such as: mint, garlic, ajwain, mooli, etc.
3		<ol style="list-style-type: none"> 1. Various types of herbs were taught to be planted
4		<ol style="list-style-type: none"> 1. Domestic waste and leftover from homes were listed down and collected 2. Fruits distributed and their peels and waste were collected while demonstrating 3. Discussion and awareness on waste management
5	Making Natural Fertilizers	<ol style="list-style-type: none"> 1. Importance of egg shells in making compost 2. Bananas distributed to eat and collected the peels 3. Demonstration and explanation on making mixture of gur and banana peel and later spray on plants
6	Saving Seeds	<ol style="list-style-type: none"> 1. Females were taught to save seeds from best looking and flavored fruit / vegetables 2. How to dry seeds for a certain period of time 3. Given airtight polythene bags 4. Demonstration and explanation
7	Harvesting	<ol style="list-style-type: none"> 1. When grown fully, most of the food was harvested

method of sowing and planting was shown to all the lady members (Figure 11).

Some samples of different sized pipes, planter and already sown various seeds with roots in trays and pots were shown to the participants (Figure 12 and 13).

The adding of fish fertilizer at a later stage of mixing the was also advised which was very essential for the plants to grow. These steps were demonstrated in the workshop.

In the second session, full-fledged demonstration of sowing seeds and transplanting (with roots) plants as mint, garlic, *ajwain*, *mooli*, was demonstrated.

In the third session, the method of planting various types of herbs was demonstrated.

In the fourth session, the domestic waste from homes were listed down and collected. Ways to dispose off waste food was demonstrated along with techniques to make compost with left over food. All the items which could be used for preparing the compost were listed down and the members were asked to memorize them. In this session of composting at home, the participants were given one big bin each. As a demonstration, some fruits were distributed and their peels and waste were collected in the given bins. Later a detailed discussion and awareness on waste management was provided by the expert.



Figure 11: Demonstration to the community ladies by the experts



Figure 12: Given seeds sown in trays and small plants in pots to the community ladies by the experts



Figure 13: Given sample of pipes for vertical garden to each lady per house

In the fifth session of making natural fertilizer, the importance of egg shells in making compost was explained. A thorough demonstration of making a mixture of *gur* and banana peel was done which was sprayed on plants already growing in the vertical gardens.

The sixth session was the seed saving sessions. It was demonstrated that the seeds available in the market were rather of low quality; hence it is beneficial to grow one's own seeds. Furthermore, they participants were taught how to dry seeds for a certain period of time. In addition the members were provided with airtight polythene bags for preserving seeds.

In the concluding session, after a certain duration when the plants were grown fully, most of the food was harvested. It was a happy moment for the community members who participated in the workshop of DIY vertical garden as all they sowed was eventually harvested.

FINDINGS AND RECOMMENDATIONS

The overall study revealed that composting in the paradigm of recycling is the most preferable alternative as it facilitates the return of nutrients back to the soil as well as kills any pathogens present. A pathogen or infectious agent is a biological agent that causes disease or illness to its host. The term is most often used for agents that disrupt the normal physiology of a multi-cellular animal or plant. However, pathogens can infect unicellular organisms from all of the biological kingdoms.

It is a known fact that recycling verifies the biogas production and composting, both of which are effective waste management techniques and were valuable ways of using organic waste as a resource. Composting converts troublesome urban organic waste into compost, an effective solid conditioner, which when combined with the practice of urban agriculture completes the nutrient cycle and leads to the production of food, as is the aim under a circular economy.

The case study of Karachi demonstrated that the city has a poorly functioning waste management system and faces a food crisis majorly in the lower income groups. However there are several examples of citizens' initiatives to manage waste effectively using composting and urban gardening. The situation analysis also revealed numerous additional difficulties faced by the city, including declining green spaces, a poor transport system, law and order problems, ethnic violence, poverty, inequality and climate change. When these difficulties were compared against the findings of the literature review and after a practical work in terms of the workshop of Learning Gardens and Vertical Gardens conducted in the selected area of Sultanabad in Karachi, it was found that composting combined with urban gardening could contribute to addressing each of these difficulties and

therefore is justified for implementation in Karachi.

A SWOT analysis however revealed a number of threats to its implementation including, water shortage, extreme weather events, an unregulated waste economy and land unavailability, with water shortage and land unavailability being the most significant threats. While community-level composting was found to be considerably more suitable for Karachi than city-level composting, on the other hand, the lack of space could make its implementation difficult.

Nevertheless, the live project conducted at Sultanabad, Karachi, amalgamated the idea on one hand that awareness and generating knowledge about nature appreciation and learning gardening, at the early stages of secondary education could develop a sense of ownership in terms of cleaning the surrounding spaces and growing food at homes and other available area around. Also the student could be one of the stakeholders in the betterment of the city.

On the other hand, if land and water could be secured and small communities could utilize their own generated organic waste through the implementation of community-level composting and urban gardening in Karachi, it could not only contribute to a better livelihood but also add to climate change mitigation, and could make the city richer, safer, greener and cleaner at the macro-level.

A thorough analysis proved that community-level composting and urban gardening are more likely to succeed and more likely to benefit both the government as well as the community. It was also highlighted that community-level composting and urban gardening can ease the financial and managerial burden on municipalities, ease the burden on transport systems, contribute to food production, and in numerous ways contribute to the building of community capital.

Composting can be implemented in a city under two ways: a centralized / city level system, which supports city horticulture, landscaping and commercial farming, and a decentralized / community-level system, where the compost generated supports household, school and community gardening. A thorough review of the city-level (centralized) versus communal-level (decentralized) composting proved that, of the two systems, community-level composting is more likely to succeed and more likely to benefit both the government as well as the community in Karachi. An exploration of this idea also highlighted the positive role that a community-level composting and urban gardening can play. It can ease the burden on transport systems,

contribute to food production, and in numerous ways, can contribute to the building of community capital.

CONCLUSION

Composting is the best way to recycle the valuable nutrients in the food that is thrown away, which on average makes up around 40% of household waste. It also produces low cost fertile soil for planting in small scale community gardens. Community garden is a great place to socialize for community members. It also helps to make indoor environment of the built structure aesthetically beautiful as well as it also provides one's own supply of fresh and hygienic fruits, herbs and vegetables.

On a larger scale, a growing number of cities are designing policies and programs for urban gardening, applying multi-stakeholder planning approaches to recognize effective ways to incorporate urban gardening into urban sector policies and urban land use planning and to facilitate the development of safe and sustainable and multi-functional urban gardens. Urban gardening has the potential to become a vibrant

economic sector that quickly acclimatizes to changing urban conditions and demands, intensifying its efficiency and diversifying its functions for the city. Governmental policy should create a proper framework for most favorable development of the social, economic and ecological benefits of urban gardening, whilst reducing harmful effects on public health and environment that some types of urban gardening can have if improperly managed or not well located.

Hence, the sustainability of urban gardening is strongly related to its contributions to the development of a sustainable and resilient city that is socially inclusive, productive and environmentally-healthy.

Composting should be promoted and widely practiced in sustainable gardening in the urban context. Awareness on composting and urban gardening should be made popular amongst the new generation from the very initial stages of the educational system. The government should include a green curriculum officially with the induction of learned trainers at all levels of education.

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