



SUSTAINABLE ECOLOGY

GREEN URBANIZATION

The Geneva Challenge 2018

International Contest for Graduate Students

The Challenges of Climate Change

A Step towards Sustainable Ecology:
Green Urbanization

CONTENTS

| | |
|--|------|
| Abstract | |
| Participants Biographies | |
| | Page |
| The Landscape Of Climate Change In The Globe | 1 |
| Urbanization and Climate Change | 2 |
| Climate Change in Asian Region | 4 |
| Urbanization and climate change: Bangladesh perspectives | 5 |
| Sustainable Urban Environment and Urban Farming | 7 |
| Green Dhaka: the Solution | 8 |
| Rooftop Gardening And The Mobile Application – A Purposed Solution | 8 |
| Public participation for rooftop gardening | 11 |
| Functionalities of the Application | 12 |
| Implementation | 15 |
| Expected Outcomes of the Project | 16 |
| Theory of Change | 18 |
| Alignment with National Strategy | 19 |
| To Conclude... | 20 |
| References | 21 |

ABSTRACT

Climate change has been contingent on anthropogenic emission and natural climate

variability since long decade. Human actions which emits greenhouse gases have highest effects on the human and natural system and weather-related disaster. Due to urbanization and growing population more greenhouse gases are being releasing in the environment in several form which is producing more urban heat island effects. To address this problem, we need a robust action plan in to initiate and continue for the future in both at the highest levels and ideally as part of a strong climate action plan which should be sustainable. Our proposal has explored the detail conditions of Dhaka city where we are going to apply our solution first where climate change is related with special effects of greenhouse gases.

Our purposed solution is rooftop gardening through mobile application known as 'Shamol' which shall introduce with the alliance with Government and Urban household committee for sustainable approach where it covered goal of Sustainable Development Goals 13,11 and 12. 'Shamol' project will help to introduce rooftops in their buildings in Dhaka city which is the most available alternative for plantation urban city of Dhaka. There will be two packages in the application, in one where users will get paid for registering their rooftops for framing purpose and another package authority where users will pay us to grow specific products; vegetables for example. Also, use of organic waste for rooftop gardening will be incorporated. The app services from the developer's end will depend highly on the needs of our clients which will run according to business model which are well described in our proposal

Meet The Team



Sachina Paudel

Sachina is a MPH student at BRAC James P Grant School of Public Health in Bangladesh. She is from Nepal, has completed undergraduate in Public Health from Nepal. She has more than 3 years work experience in the field of public health.



Salman Khan Promon

Salman is currently enrolled as a master's student of Biotechnology program in BRAC University. He is working as a Teaching Assistant and researcher in BRAC University, Dhaka.



Shagoofa Rakhshanda

Shagoofa is currently undertaking her MPH from the James P. Grant School of Public Health, Bangladesh. She did her Bachelor and Master Degrees in Biotechnology from BRAC University, Bangladesh.



Syed Hassan Imtiaz

Imtiaz is currently enrolled in MPH the James P. Grant School of Public Health. He has completed his M.Sc Degree from the Dep't of Genetic Engineering & Biotechnology, University of Dhaka.

THE LANDSCAPE OF CLIMATE CHANGE IN THE GLOBE

Climate change is a condition when usual weather of any places found to be changed, for example the amount of rainfall, usual temperature for a month or for a season. Climate change is not a new phenomenon. It takes hundreds or even million years to change the climate of a country or a region (NASA, 2017). Previously climate change was being limited within a region but it has been eventually expanded due to the increased greenhouse gases which eventually surges temperature and concentration of pollutants in the environment and now the problem is recognized as a universal (IPCC 2014). Various research and studies already demonstrated that the climate change is known as a greatest environmental challenge of this century (Mehta, 2002). Climate change has undoubtedly been one of the most pressing and widely discussed environmental issue. Human activities are the main reason for increasing greenhouse gases in the environment which have various impacts on climates. The impacts caused by climate change are increasing rapidly, reaching unprecedented and unpredicted levels.

Climate change brought heaps of effects. The most conserving one is the warmer surface of earth. Since 1850, earth surface has been getting warmer because of emission of greenhouse gases due to human activities (Mehta, 2002). The air temperature on a global scale has increased by 0.74 °C during the 20th Century (IPCC, 2007) which have highest effects on the human and natural system and also weather-related disaster over all the continents and across the oceans (IPCC, 2014, Mehta, 2002). Only the small changes in Earth's temperature can have big effects on all creatures and system. The atmosphere and ocean have been warming and snow and ice have been demised and the sea level have been diminished (Tilman, Balzer, Hill, and Befort, 2011). The changes may manifest as changes in temporal and spatial distribution of precipitation; frequency and intensity of storm, and flooding; more frequent droughts; and decrease in snowfall annually. Consequently, the watershed characteristics become more vulnerable changes in the temporal and spatial distribution of runoff (Franczyk and Chang, 2009).

Climate change have been affecting millions of people in the basic needs of life - food, water, shelter, health to the various different ways, making environment more hazardous to have sustainable life (WBG, 2016, Mehta, 2002). Because of the adverse effect of climate change, about 2000 people died and 5.5 million people lost their healthy life (DALYs) (Costello et al., 2009). The situation has becoming worse day by day because of increasing world population, rapid unplanned urbanization and industrialization globally. Therefore, climate change has become a global priority. In the recent Paris Climate Conference by IPCC (COP21) in Paris, 140 World Bank client's nations agreed on implementing Nationally Determined Contributions (NDCs) in order to limit global warming less than 2°C by 2100 (WBG, 2016). Additionally, they also make best efforts to limit warming to 1.5°C and made an action plan for 2016 to 2020 with supporting international policies and institutions of climate change (WBG, 2016).

Urbanization and Climate Change

Over the past decade, there has been a major shift of population from rural to urban areas (WHO, 2010). More than 50% of the world's population is living in urban areas which is rapidly rising (Costello et al., 2009). It is estimated that about two billion new people will migrate to urban areas by 2050 who will require housing and access to energy (WBG, 2016). Due to Urbanization and increasing population more greenhouse gases are emitting in the environment in different form like motor vehicle uses and other technology in urban areas. This kind of rapid shift is the root cause of many health-related problems that are associated with poor sanitation and drainage system, water borne diseases unhealthy diets leading to obesity, non-communicable diseases, reduced physical activities, human settlement and migration, aging population, food security and others (WHO, 2010; Costello et al., 2009). Besides, combustion of fossil fuel and other advances in technology lead to air and water pollution and changes in ecology of infectious diseases concerning health status (Kan, Chenand Tong, 2012).

There have been many studies which shows that urban areas usually have high heating than rural areas (Fischer et al., 2012; Dan Li et al., 2014). Results of which we often face raising of the

temperatures of air, surface and soil more in urban than rural areas. This effect is known as the Urban Heat Island (UHI) which is 1st termed in mid-20th century (Chan et al., 2007). Greenhouse gases (GHGs) is the main reason for climate change in city areas not the urbanization. In developed world high release of greenhouse gases (GHGs) is recognized as a main factor for the climate change (Campbell-Lendrum and Corvalán, 2007). Initially in order to explore the factor affecting climate change in urban area various studies have been conducted in various countries even in the prolong winter season for considering the potential effects of the heating effect (Stewart et al., 2012). It has clearly seen the increase in the temperature effects even removing confounders which was known as the Urban Heat Island (UHI) effect of cities which have greater influence in climate change (Chan et al., 2007). Conversely, increase in population make the urban area hotter and warmer. Because of need of population demands of indoor cooling have been emerged, which is also another factor for increase in temperature which emphasized on climate change. Temperature analysis done by NASA's Goddard Institute for Space Studies (GISS) found that average temperature of the earth is increased by 1.4 degree Fahrenheit since 1880 to 1970 on average rate of 0.3 degree Fahrenheit, was 1.69 degree Fahrenheit in between 1880 and 2015 but since 2016 it's getting on 1.69 degree centigrade, which needs attentive attention from every places of the earth (GISTEMP Team, 2018 and Hansen et al. 2010). Some countries have incorporated the worst pollutants and the most energy incompetent industrial enterprises in the world. This unplanned urbanization has made the problem even worse by toxic emission by factories which were located directly in or nearby major urban centers.

To tackle such the problem and challenges regarding this some bold action is needed to contribute to the solution of the climate challenge and should be sustainable and considerable and also visible with supportive people (Stocker et al., 2015). We need a strong action plan in a long term way to initiate and continue for the future in both at the highest levels and ideally as part of a strong climate action plan needed. The solution that have been purposed previously only focused on immediate measure rather than of the sustainable approach in the sector of climate change (Campbell-Lendrum and Corvalán, 2007). Hence, an integrated management of environment is expected to have beneficial effect on public health, economy and environment. (Kan, Chen and Tong, 2012). Also, proactive leadership approach to climate change should be

accompanied by a suite of actions to address the problem at all levels (Stocker et al., 2015). Climate change represents one of the sector which needs integrated way to tackle huge challenges and also have opportunities for development (WBG, 2016).

Climate Change in Asian Region

It has been projected that 60 percent of all the city growth will occur in Asia by 2030 (Balk, Montgomery, & Liu, 2012) where urban population in South East Asia shall surge by 1.75 times quicker than the world's population incensement (Taylor, 2009). In 2006, only 36 percent people lived in Southeast Asia which have been projected to increase to 56.5 percent by 2030 (Taylor, 2009). The countries are transferring towards highly urbanized in the process form villages to town and town towards mega-cities without proper planning, one of the example in SEA is Singapore which is 100 percent urbanized (Taylor, 2009). This type of rapid urbanization leads to climate change and vulnerable health hazards which is actually being a problem of poorer countries (Campbell-Lendrum and Corvalán, 2007). High emission of greenhouse gases in SEA region was seen because of growing population demand from the rising energy and also through burning of fossil fuels that pollution (Taylor, 2009). It has been estimated that due to energy generation and consumption in Southeast Asia, carbon dioxide emission will be increased by four folds from 2002 to 2030 (Taylor, 2009). Also, it has been found that the urban improper urbanization often leads to environmental hazards, because of the improper urbanization housing will be in riskier areas because of unmanaged urbanization. Due to which around 35% of the city population of Thailand, Lao, Vietnam and Bangladesh are at the risk of land flooding from the effect of climate change (Balk, Montgomery, & Liu, 2012). Land – locked countries like Nepal is also facing the problem of in –land flooding of 13 % due to urbanization and climate change. Similarly, 18% of Chinese, 50% of Bangladesh, 20% of Taiwanese urbanites are at risk of coastal flooding due to changing climate. (Balk, Montgomery, & Liu, 2012). Therefore, we need to think about the proper and healthy urbanization where we can plan accordingly which have very different implications for GHG emissions which will eventually make have positive health impact on the people living in urban area (Campbell-Lendrum & Corvalán, 2007).

Urbanization and climate change: Bangladesh perspectives

Due to variation in topological and geographical features, some countries are more susceptible than others to the impact of climate change. According to National Geographic, Bangladesh is considered as one of two nations that has to bear the consequences of global climate change. In the 2017 edition of Germanwatch Climate Risk Index, Bangladesh was placed sixth among 180 countries most affected by climate related disasters during 1996–2015 (Eckstein, Kunzel and Schafer, 2018). Effects of climate change along with several other factors lead to impoverization. It has been found that by 2100 that the sea level in Bangladesh will be risen by 3 feet due to change in climate (World Bank, 2011).

Bangladesh with its frequent disasters has long served as a natural/quasi laboratory for innovative solutions applicable for the developing countries. It has sprinted back after each crisis proving it to be far more resourceful than guessed by many skeptics. Presently, urban areas in Bangladesh, especially Dhaka city is the most vulnerable due to the temperature rising issue. Another aspect of urbanization is the engulfment of cultivable land for housing and industry, provoking exploration of new venues to increase food production through urban agriculture.

Dhaka which is known as the capital city of Bangladesh is one of the densely populated cities in the world. Due to large number of population concentration, the mega cities are experiencing adverse effect of climate change around the world where Dhaka is also one of them. In the past 5 years, the temperature of Dhaka has increased at an average rate of 0.11°C (Rabbani, Rahman and Islam, 2011). Also, it has been predicted that the annual temperature raise will be 0.4 to 0.72 degree Celsius by the year 2050 (Karmakar and Shrestha, 2000). Over the last few years, Dhaka continuously encountered heat and cold waves which resulted in heat strokes and loss of productivity at the individual level, especially within the lower income community (Rabbani, Rahman and Islam, 2011). Alongside all these, Dhaka is also effected by cyclones and storm surges. The continuous rainfall and cyclonic wind gives way to difficulty in the water logged, low-lying parts of the city (Kabir, Rahman, Smith, Lusha and Milton, 2016). Some of the effects of

climate change on human health is seen by the changed distribution of vectors that cause some infectious diseases, increased heat wave-related deaths, change in the number of episodes of diarrhoeal and malarial cases, and the injuries and effects of floods and/or landslides (Rahman, 2008).

The crucial reason of increasing temperatures in Dhaka city is high concentration of carbon dioxide in the air due to burning of fossil fuels in the vehicles, indoor cooler besides and unplanned industrial products. Unplanned urbanization and lack of adequate plantations in the city have worsen the situation. The UN-World Health Organization mentioned that about 9 m² greenery space is needed per capita for a better environment. However, at present, there is about 2m² greenery area per capita in Dhaka city (Jaman et al., 2017). Only 5% of the total areas of Dhaka city has green spaces whereas the recommendation is at least 25% of the total area of a city should have greeneries for it to be healthy and livable (United News Bangladesh, 2016). According to a report from (World Bank Group, 2018), the quality of air in Dhaka is ranked as third most polluted in the world. Lack of attention of Government towards plantation and maintenance, low level of monitoring in the policy, unplanned urbanization and maintenance is directly infusing the rising temperature and living condition of the people.

According to several newspaper articles and research, it was observed that the most affected areas of Dhaka are Mirpur, Banasree, Sher-e-Bangla Nagar, Gabtoli, Rayer Bazar and Uttara (Begum et al., 2011). However, the exact data is not much available in the Dhaka city because of less concern from the government side. Dhaka have implemented some strategies to increase plantation and reducing the effect of climate change by saving forest and promoting plantation and planting trees on the side walk of the main roads. In the Southern and Northern part of the city plantation were targeted to maintain greenery but most of the intervention failed due to rapid urbanization and unplanned development of works (Zaman and Laing, 2013).

Sustainable Urban Environment and Urban Farming

Urban rooftop plantation or gardening will be a thriving issue in the upcoming generations where cities will construct the major part of the countries. Urban rooftop gardening holds the issue of space saving and plantation at the same time. In the upcoming days where cities will grow bigger, cultivation lands and forestry lands will certainly go down. Because of this decreasing land for plants, urban temperature increase is on the go, a direct result of climate change to be more exact. In this case, urban rooftop gardening creates the scope of making cities green along with cultivation of required plants. Moreover, rooftop gardening will be a key to fight against increasing temperature of the cities.

Green roofs and vertical gardens have been effectively implemented in urban area to impose environment and our value of life which can help to diminish some of the effect that urbanization inflicts on the surroundings and our quality of life. For reducing the impact of climate change vertical gardens is being successfully attained in some places in the world, specifically Europe and North America (Carpenter, 2008). Similarly, In China the vertical garden is being a resolution for improving the quality of air, adjusting humidity (Zeng, 2014).

Even though Dhaka have very less space and it is losing its plantation space day by day. Increasing population with increasing residential buildings are paving the way to cut down trees. Urban farming has other benefits too such as reducing food transportation distance, optimizing waste recycling, reducing wastage, and enhancing urban biodiversity (Sanye-Mengual et al., 2015). Any discussion or intervention in the management of effects of climate change, public participation is one of the important factors. Nevertheless, the ratio between investment and benefits appreciated by public is a vital factor to determine their participation in urban plantation system including rooftop gardening. A sound business strategy with forward and backward linkage, and integrated efforts may stimulate public to participate in urban plantation. Therefore, sustainability of urban environment can be achieved to a certain degree through the implementation of the proposed business model.

GREEN DHAKA: THE SOLUTION

ROOFTOP GARDENING AND THE MOBILE APPLICATION – A PURPOSED SOLUTION

The purposed solution is the rooftop gardening in Dhaka city. Rooftop gardening is a common practice all over the world. These are commonly practice in countries from Northern Europe (such as Norway) where it is used to increase thermal insulation (Coutts, Daly, Beringer and Tapper, 2013). American architects started rooftop gardening in order to incorporate nature in buildings (Coutts, Daly, Beringer and Tapper, 2013). This concept is also seen in France and Germany, where it is used to reduce urban heat (Dunnett and Kingsbury, 2008). A properly designed and maintained rooftop garden can help to replenish for the lost greeneries that that is taken up by the blooming urbanization in cities (Bates, Sadler and Mackay, 2013). Rooftop gardens can enhance the energy efficiency of buildings and can prevent penetration of solar heat into buildings (Castleton, Stovin, Beck and Davison, 2010; Morau, Tiana and Ludovic, 2012). The plants can photosynthesize and the layer of soil can absorb rainfall, which results in increased quality of water runoff (Bates, Sadler and Mackay, 2013). Studies have shown that rooftop gardens can reflect between 20% and 30% of radiation from sun, and absorb 60% of it through photosynthesis. It was also further found that vegetation helps in adjusting land surface temperature (Weng, Lu and Schubring, 2004; Berardi, Hoseini and Hoseini, 2014). When roof is covered with green soil/vegetation coverage it lower the air temperature on the rooftop and eventually more than 75 % of the roof would have any measurable effects on the urban island (Dubbeling and Massonneau, 2014)

Objective

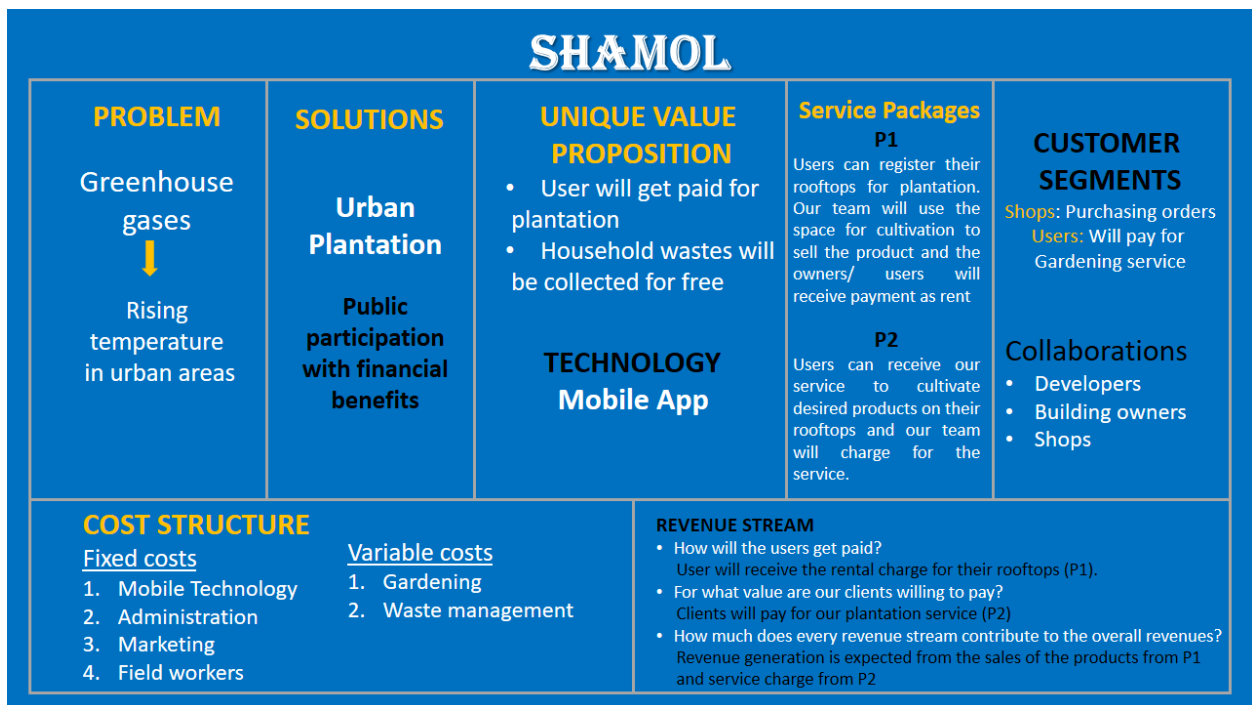
The objective of this proposed project is to make more greenery spaces in Dhaka city which shall help Dhaka city temperature to lower down and which will have impact on climate change.

Description of the Solution

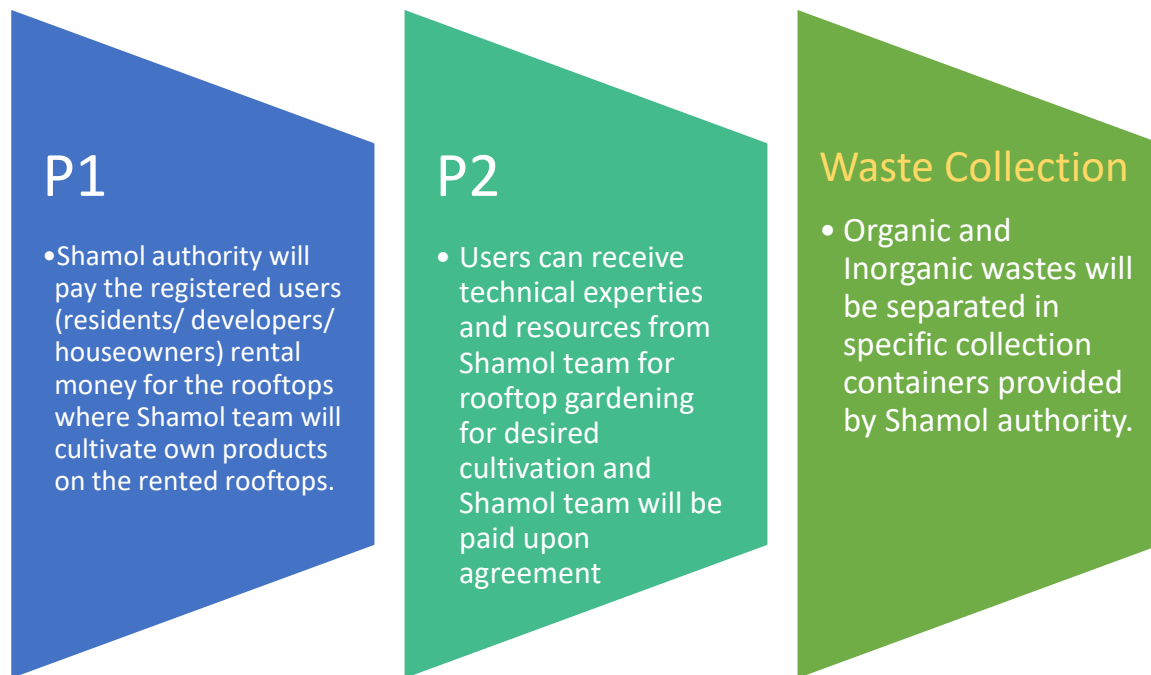
We shall introduce a mobile application named ‘Shamol’ as a platform to encourage and assist Dhaka city residents for rooftop gardening. This mobile app will provide necessary information about rooftop gardening, assist interested people to get vegetables and fruits plants/seeds and other accessories necessary for cultivation. There will be financial benefits for the house owner if he/she wanted to rent their rooftop for gardening purpose or produce vegetables and fruits by their own and sell the products to the local market. The mobile app will also link interested people with local market places to sell their products. As an additional service, households registered to the Shamol mobile app will also be taught household waste management. Waste will be managed where two different color buckets shall be providing to household who are enrolled in this project for using household organic waste for rooftop gardening purpose. This will eventually reduce the burden of work towards the waste collector’s municipalities in Dhaka.

The purposed solution of the problem and uses of mobile technology and whole structure are graphically presented below:

SOLUTION MODEL



For better understanding and effective functionality, our service offerings are presented in two packages namely P1 and P2. Separation of household waste will be done by providing two separating containers. One will be organic and another will be inorganic and organic portion shall be used for rooftop gardening purpose. The mobile application will be used to build the network and provide our services.



Shamol- Mobile Application to Build a Functional User Network

The meaning of 'Shamol' means 'Green' in Bengali, which shall be easier for people to understand. Shamol is a platform by which our services can be accessed by a larger public. By installing the application, users can register their rooftops to the network. Enlisting will be done online through the application with required details and inquiries. The app services from the developer's end will depend highly on the needs of our clients (purchase orders). The server will enable us to monitor available rooftops for purposed production. The app will calculate the financial charges according to the area provided by users for cultivation. Information regarding waste management, especially the organic waste will be included in the app for those who have taken place in the registration. We will collect wastes for acceptable separation of organic and recyclable at the households' level for further processing. Specific organic wastes will be used as fertilizers in the rooftop plantation system.

Public Participation for Rooftop Gardening

The mentioned operational method of 'Shamol' will allow users to become part of the network by which our primary goal that is urban plantation can be instigated. Here the rooftops of the target clients for example building owners, building developers will be rented for farming purpose. Registered citizens will receive an additional service of free information and mechanism of making organic household waste. This practice can also be a source of organic foods like vegetables for the users if they use only the farming service for themselves where our team will connect them to the service provider for connecting them to sell the products. Recently, various user network based mobile technology, more specifically mobile applications are very significant examples for this kind of businesses. Integrated Client-Server model and home service is the principal action plan for this business. This approach can be found in network based business like Uber, where a network of service provider will be used by multiple users based on needs. In modern days, online based business platform is becoming a vital part. Uber has brought an evolution in the system, where a group of service providers are connected by mobile application where they are getting paid for their service. The factor playing a key role is the method of accessibility and the security. The participation of service provider or users are tending to be higher in these kind of business due to the easy accessibility which is possible for the mobile application. The operation and data management become easier and get a well-structured with minimum effort. The both end beneficiaries in this system makes it more successful for its target.



Functionalities of the Application

Pay for features and getting paid are two packages which will be operated between the business and user groups. In the case of building a user network, the very first thing is to establish an application platform with specific operational features. Upon registration as a profit organization, the server is to be constructed and the user requests will be screened out according to the business packages (P1 and P2). The operational properties of these system are explained in the infographic section.



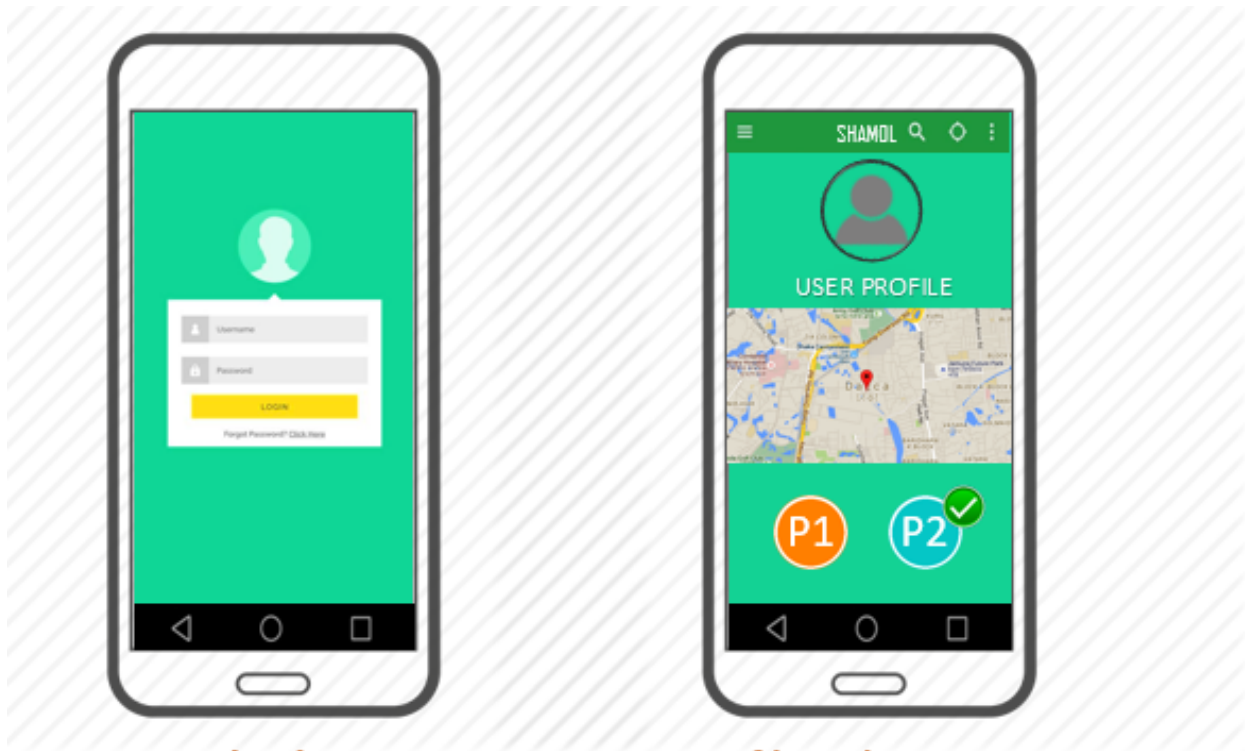
Download and Install

After installation, **Sign Up** button will take user to the registration section.

Registration and Services

Registration with specific information is required to create user profile and log in the system.

After installation, the app will require specific information from the users to log in using phone number or email. Users have to select language, provide identification information with a profile photo, address and contact details. Aforementioned information will be stored in our database under user's profiles. After successful registration by creating profile, users can select which of our services they want to avail.



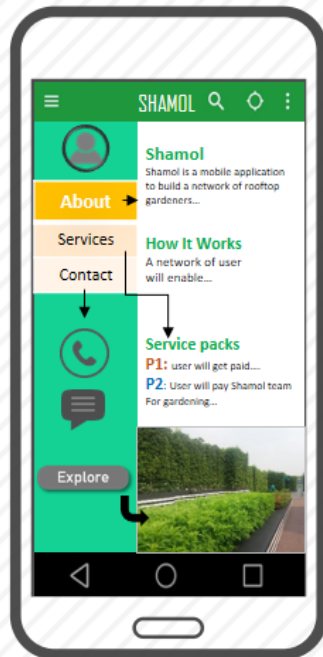
Log In

User can log in to the system with registered **'User name'** or **'Phone number'** and **'Password'**

Profile and Service Status

User profile will contain registered information of the rooftop, user's profile including necessary information with Location and profile photo.
Service status (P1 /P2) will be visible based on selected service package.

Based on the selection of the options by the mobile applications, registered rooftops will be categorized according to user's need. Option can be selected for **"P1"** where user will get paid for registering their rooftops for farming or **"P2"** provided by Shamol authority where users will pay us to grow specific products; vegetables for example. The household waste collection from the registered users will be a free service. Enquires, problems, comments or service requests can be sent through the "Shamol" application and direct phone hotline by the registered users.



About Shamol

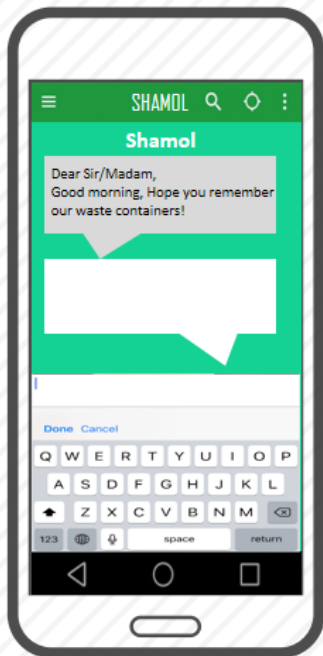
Home page of the application will contain a menu-bar consisting:

Profile button to access User Profile

About section with our information
Services section with the description of our services

Contact Section with one tab call/message to our communication service

Explore section where user can take a virtual tour to our projects



Shamol Inquiries

- User will receive regular reminders about services and necessary information.
- This messaging option can also be used for any queries



Explore

Our **Explore** section contains information about

Other projects, gardening and waste management tips

Find People option will connect the users with our rooftop gardener's network

Implementation

To influence the target population of Dhaka, we need a proper advertisement and network which will be done using social media, print and electronic media, door to door marketing and other available platforms. Also, we shall advocate to the municipal agencies to increase the acceptability of the system and our implementation strategy which includes the invitation to city corporations for their active support. Similarly, Collaboration with builders and housing companies is required for the successful urban farming network since they are the owners of a largest share of buildings in the urban areas of Dhaka. Primary source of revenue are the local shops and super shops from where we are expecting purchase orders of products like vegetables will be done. Secondary source of our income is our paid gardening service to the registered users from which the revenue will be collected for sustainability purpose.

Most important part of the process is the active participation of users which will be managed by our mobile application system. User data will be maintained by a server and from the registration information provided by the users, the system can determine the status of rooftops in selected areas. Registered users will receive fees as rental money from us for their rooftops (our service package: P1) according to the agreement which is the main added value of Shamol alongside our free household waste collection service. Shamol authority will arrange separate waste disposal units for organic and inorganic wastes to the users who are willing to receive the waste collection service. Organic and inorganic waste will be sorted out and proper disposal will be arranged by systematic collaboration with municipalities. Separated biodegradable wastes will be used as organic fertilization in the rooftop gardening system. Users can also select our gardening service “P2” as mentioned earlier.

Not to mention the opportunity of consuming organic and fresh products for example vegetables which can be availed by the user by accepting our P2 service package. Either of the two services (P1 and P2), urban plantation will be achieved on the rooftops. Our mobile application will increase the chance of reaching active participants and create a functional user –friendly system to increase the user network thus urban plantation.

Number of beneficiaries of the application will be monitored by the system. Cultivation of specific products will be done according to the purchase orders from the shops. Our trained gardeners will cover listed rooftops according to the specified location and time. Cultivation, maintenance, harvesting and transportation will be supervised by skilled personals of Shamol authority. Necessary information regarding gardening can be obtained by the user from the mobile app according to user's rooftop condition and user specific consultation regarding cultivation will be provided.

The use of mobile technology of this service can provide valuable data that can be helpful analyzing the impact of urban plantation on temperature rising issue in urban areas along with the strategy of making more green spaces in Dhaka city by increasing public participation. Increment of public involvement in rooftop gardening is offered by our system by one of the services P1 where users will receive payment for rooftops for renting. Additionally, the household waste management by separating organic and inorganic waste is potent to have indirect impact in the reduction of environmental pollution.

Expected Outcomes of the Project

Additional green spaces in an urban environment has well- identified environmental benefits. A major barrier for urban agriculture is accessing lands (Balk, Montgomery and Liu, 2012) and rooftop are practical solution to this issue. Our main focus is to reducing the temperature which is one of the impact from greenhouse effects which is the cause of climate change where rooftop gardening will have tremendous benefits on temperature such as impending reduction of heating, create better biodiversity and will improve visual value and quality of air (Dubbeling and Massonneau, 2014). Along with the urban plantation service our project can potentially have a concept of organic waste management which will help in composting of gardening and eventually has direct impact to the environmental pollution reduction. The awareness needed for environmental safety and addressing environmental problem will be greatly influenced by the process. Needless to say, the project will create employment for specific group since manpower is needed in every sector of the system. Home values and household income are reported to

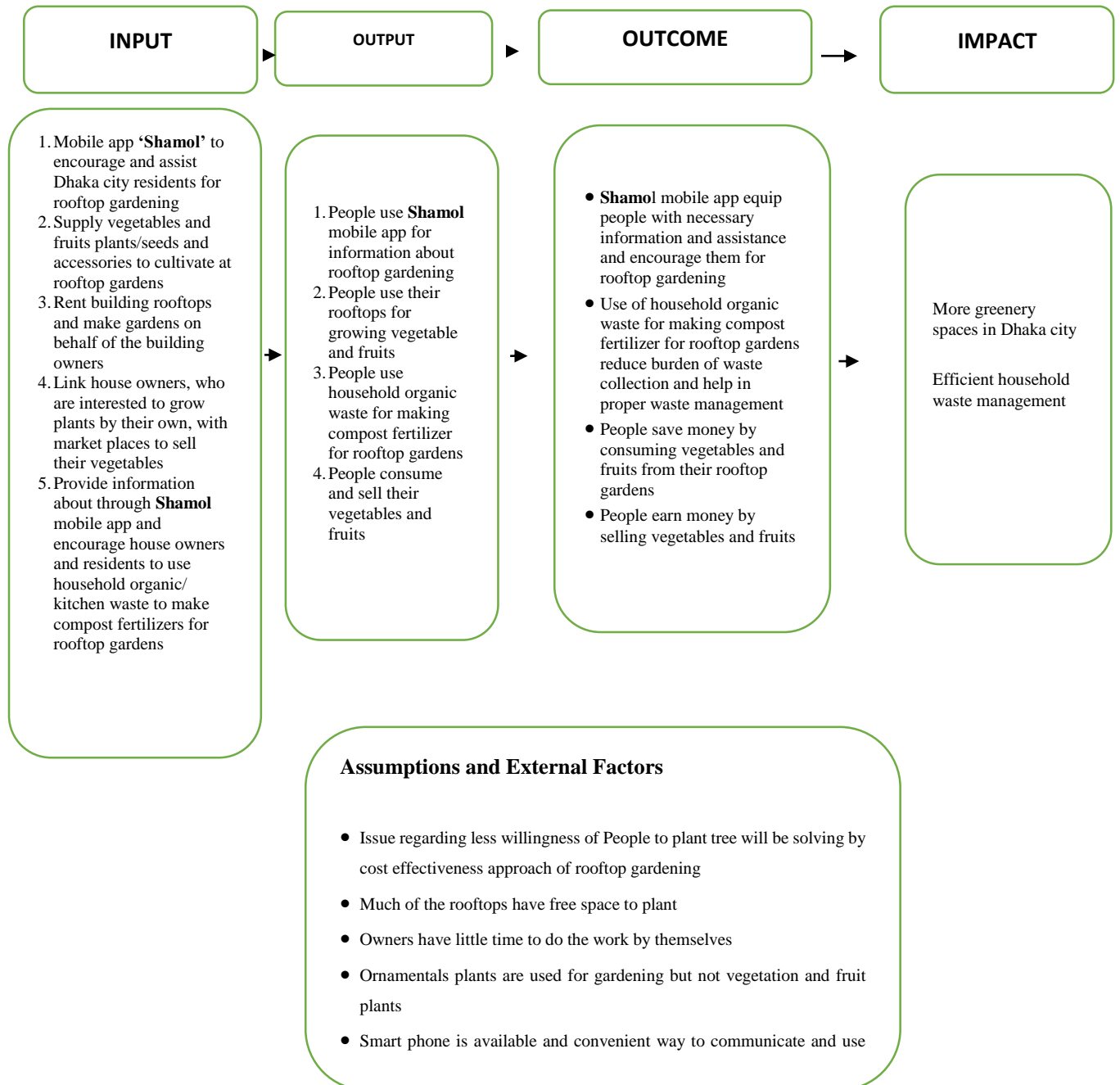
increase for practicing of urban farming in form of rooftop gardening (Liu, 2008; Voicu and Been, 2008). Moreover, urban farming can be a source of organic vegetables and other relevant products. Fruit and vegetable consumption are evident to rise due to urban farming (McCormack et al., 2010). Successful supervision on food production by the rooftop farming process can ensure food safety to some specific degree. Municipal agencies can also be benefited by the third-party involvement in waste management. This collaborative approach of green urbanization and household waste management can be a substantial step to a sustainable urban environment.

Urban heat island effects which have been taught before which is a prominent problem of urban area large – scale roof planting which can reduce the UHI effects. This work in mechanism over protecting, heat absorption through thermal plant and evaporation and cooling purpose. The purposed solution will work as a solar reflection and evapotranspiration in order to reduce air temperature (Dubbeling and Massonneau, 2014). Several environmental impacts, such as reducing heat island effects, recycling waste are the outcomes of urban plantation with which the social, economic, and health impacts are also visible (Golden, 2013).

The purposed solution is in the form of action which shall incorporate for attainment of multiple to SDG 11, 12 and 13. SDG 13 is about climate change which focus on taking crucial and prompt action regarding combat climate change. The purposed action is also the needed for accomplishment this SDGs by 2030. Sustainable cities and community which is SDGs goal 11 have focuses on well management of urban area and incorporating the fact that 75 percent of carbon emission was from urban areas with 60-80 percent of energy consumption (UN Environment Programme, 2018). As we are focusing on urban area it will be the action towards reaching SDGs 11 by the reaching the target and the goal. Provide access to green public spaces for all age group of people with special focus too vulnerable like children, women and disable people is in 11.7 target of SDGs (UN Environment Programme, 2018).

Theory of Change

Plantation of vegetative plants on the rooftop helps in decreasing the temperature of the air around the plants. When done in a mass scale, it leads to the overall decrease of temperature of the climate by about 2°C.



Alignment with National Strategy

The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009 is a national plan of action of the Government of Bangladesh with an aim to strengthen country's capacity to deal with different challenges country is facing due to climate change (MoEF, 2009). The BCCSAP 2009 has built on six main pillar – 1) Food security, social protection and health, 2) Comprehensive disaster management, 3) Infrastructure, 4) Research and knowledge management, 5) Mitigation and low carbon development, and 6) Capacity building and institutional strengthening. This proposed project is aligned with the two programs designed under the fifth pillar – T5P6: Management of urban waste and T5P7: Afforestation and deforestation program (MoEF, 2009). The objective of this proposed project of increasing greeneries in urban spaces through rooftop gardening will add value to the government's initiative of plantation for reducing carbon emission. This initiative will also eventually contribute in increasing food security by producing vegetables and fruits in the rooftops of the buildings. In addition, the waste management mechanism outlined in this proposed project will contribute in reducing the production of methane from household organic wastes and thus making city clean.

To Conclude...

Warmer temperatures are being a region for producing hazardous ozone air pollution in the urban areas which is the reason for significant adverse impact on health. In addition to that CO₂ is inducing nutritional deficiencies due to which health hazards have been increasing in the urban areas. The purpose model of 'Shamol' will help to decrease the temperature and reduce the amount of greenhouse gases. By lowering the CO₂ level from the area it will help to reduce the health impacts as it will also increase the nutritional foods in the market too. It has both short term and long term effects in the climate in urban area like Dhaka. Short term effects would be encouraging people to have healthy diets which will be grown in their own roof and long term benefits would be sustainable changes in the temperature by reducing the greenhouse gasses emission at the local level over the coming decades. Increased annual temperature have made various effects on the pattern of rainfall also. The effects of these are already seen in food scarcity, it can eventually lead to famine and have been affecting the whole economy situation and infrastructural too. Promoting this project in urban area will eventually help people to solve their problem by themselves.

Shamol project will help to introduce rooftops in their buildings in Dhaka city which is the most available alternative for plantation urban area. The main purpose of having this rooftop gardening is for helping to lower the temperature by reducing the impact of greenhouse gases.

References.....

- Balk, D., Montgomery, M. R., & Liu, Z. (2012). Urbanization and climate change hazards in Asia. Population Association of America, 2013 Annual Meeting.
- Bates, A. J., Sadler, J. P. & Mackay, R. (2013). Vegetation development over four years on two green roofs in the UK. *Urban Forestry & Urban Greening*, 12(1), 98-108. Retrieved from: <https://doi.org/10.1016/j.ufug.2012.12.003>.
- Beguma, B. A., Kamal, M., Salam, A., Salam, A., Salam, M. A. and Biswas, S. K. (2011). Assessment of Particulate Air Pollution at Kalabagan and Shisumela Area Along the Mirpur Road, Dhaka. *Bangladesh Journal of Scientific and Industrial Research*, 46(3), 343-352. Retrieved from: <file:///E:/BRAC/Masters/Ambreen/Geneva/9041-33051-1-PB.pdf>
- Berardi, U., Hoseini, A. H. G., Hoseini, A. G. State-of-the-art analysis of the environmental benefits of green roofs. *Applied Energy*, 115(2014), 411–428. Retrieved from: <http://dx.doi.org/10.1016/j.apenergy.2013.10.047>
- Campbell-Lendrum, D., & Corvalán, C. (2007). Climate change and developing-country cities: Implications for environmental health and equity. *Journal of Urban Health*, 84(1), 109–117. Retrieved from: <https://doi.org/10.1007/s11524-007-9170-x>
- Carpenter, S. (2008). Green Roofs and Vertical Gardens. International Specialized Skills Institute, (November), 48. Retrieved from <http://www.scribd.com/doc/118225286/green-roofs>
- Castleton, H. F., Stovin, V., Beck, S. B. M. and Davison, J. B. (2010). Green roofs; building energy savings and the potential for retrofit. *Energy and Buildings*, 42(10), 1582-1591. Retrieved from: <https://doi.org/10.1016/j.enbuild.2010.05.004>.
- Chan, C.F., Lebedeva, J., Otero, J., Richardson, G. (2007). Urban Heat Islands: A Climate Change Adaptation Strategy for Montreal. The Climate Change Action Partnership, McGill University School of Urban Planning.
- Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., Puppim de Oliveira, J. A., Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J. & Patterson, C. (2009). Managing the health effects of climate change. *The Lancet*, 373(1), 1693–733.
- Coutts, A. M., Daly, E., Beringer, J. & Tapper, N. J. (2013). Assessing practical measures to reduce urban heat: Green and cool roofs. *Building and Environment*, 70(1), 266-276. Retrieved from: <https://doi.org/10.1016/j.buildenv.2013.08.021>.
- Dubbeling, M., & Massonneau, E. (2014). Rooftop agriculture in a climate change perspective. *Urban Agriculture Magazine*, 1(27), 28–32. Retrieved from:

https://s3.amazonaws.com/academia.edu.documents/37598221/UAM_27-Urban_agriculture_as_a_climate_change_and_disaster_risk_reduction_strategy.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1534752186&Signature=kBTOS5uwLocrFsiQ7vOYSU1kZec%3D&response-content-disposition=inline%3B%20filename%3DUrban_agriculture_as_a_climate_change_an.pdf#page=28

- Dunnett, N. & Kingsbury, N. (2008). *Planting green roofs and living walls*. Portland, Oregon: Timber Press.
- Eckstein, D., Künzel, V. & Schäfer, L. (2018). Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2016 and 1997 to 2016. *GLOBAL CLIMATE RISK INDEX 2018*, 1-36. Retrieved from: <https://germanwatch.org/en/download/20432.pdf>
- Fischer, E. M., Oleson, K. W. & Lawrence, D. M. (2012). Contrasting urban and rural heat stress responses to climate change. *Geophysical Research Letters*, 39(L03705). doi:10.1029/2011GL050576
- Franczyk, J. & Chang, H. (2009). The effects of climate change and urbanization on the runoff of the Rock Creek basin in the Portland metropolitan area, Oregon, USA. *Hydrological Processes*, 23(1), 805–815. doi: 10.1002/hyp.7176
- GISTEMP Team, 2018: GISS Surface Temperature Analysis (GISTEMP). NASA Goddard Institute for Space Studies. Dataset accessed 2018-08-16 at: <https://data.giss.nasa.gov/gistemp/>.
- Golden, S. (2013). *Urban Agriculture Impacts: Social, Health, and Economic: A Literature Review*. California, Agriculture and Natural Resources, University of California. Retrieved from: asi.ucdavis.edu/programs/sarep/publications/food-and-society/ualitreview-2013.pdf
- Hansen, J., Ruedy, R., Sato, M. & Lo, K. (2010). Global surface temperature change. *Reviews of Geophysics*, 48(4), 1-29. doi:10.1029/2010RG000345.
- Intergovernmental Panel on Climate Change. (2007). *Climate change 2007: Impacts, adaptation and vulnerability*, 1-976. Retrieved from: https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf
- Intergovernmental Panel on Climate Change. (2014). Who is who in the ipcc. 96 – 97. Retrieved from: http://www.ersilia.org/canvi_climatic/documents/ipcc/ipcc_whoiswho.pdf
- Jaman, M. S., Jahan, I., Jamil, M., Helal, M. G. J., Islam, M. S., Azad, M. J. & Hossain, M. F. (2017). Structure and Composition of Plant Vegetation in Urban Area of Dhaka South City Corporation, Bangladesh. *Preprints*, 2017(1), 1-21. doi: 10.20944/preprints201711.0136.v1.
- Kabir, M. I., Rahman, M. B., Smith, W., Lusha, M. A. F. & Milton, A. H. (2016). Climate change and health in Bangladesh: a baseline cross-sectional survey. *Global Health Action*, 9(9), 1-9. doi: 10.3402/gha.v9.29609.
- Kan, H., Chen, R. & Tong, S. (2012). Ambient air pollution, climate change, and population health in China. *Environment International*, 42(2012), 10–19. doi:10.1016/j.envint.2011.03.003

- Karmakar, S. & Shrestha, M. L. (2000). Recent climatic changes in Bangladesh. *SMRC*, 4(1), 1-43.
- Li, Dan., Bou-Zeid, E. & Oppenheimer, M. (2014). The effectiveness of cool and green roofs as urban heat island mitigation strategies. *Environmental Research Letters*, 9 (2014), 2-17. doi:10.1088/1748-9326/9/5/055002
- Liu, J. (2008). Whitmire Study: Gateway Greening Community Garden Areas, Reversing Urban Decline. *Gateway Greening*, 1-11. Retrieved from: http://actrees.org/files/Research/gateway_greening_whitmire.pdf
- McCormack, L. A., Laska, M. N., Larson, N., & Story, M. (2010). Review of the nutritional implications of farmers' markets and community gardens: a call for evaluation and research efforts. *Journal of the American Dietetic Association*, 110(3):399-408. doi: 10.1016/j.jada.2009.11.023.
- Mehta, P. K. (2002). Greening of the concrete industry for sustainable development. *Concrete International*, 24(7), 23-28. Retrieved from: <http://ecosmartconcrete.com/docs/trmehta02.pdf>
- MoEF, (2009). Bangladesh Climate Change Strategy and Action Plan 2009. Ministry of Environment and Forests, Government of People's Republic of Bangladesh, Dhaka, Bangladesh. xviii + 76pp.
- Morau, D., Tiana, R. H. and Ludovic, A. A. (2012). Simple Model for the Theoretical Survey of the Green Roof Thermal Behavior. *Journal of Technology Innovations in Renewable Energy*, 2012(1), 92-102. Retrieved from: <http://www.lifescienceglobal.com/pms/index.php/itire/article/viewFile/428/pdf>
- National Aeronautics and Space Administration. (2014, May 14). What is Climate Change? NASA Knows! (Grades K-4). Retrieved from: <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html>
- Rabbani, G., Rahman, A. & Islam, N. (2011). Climate Change Implications for Dhaka City: A Need for Immediate Measures to Reduce Vulnerability. *Resilient Cities: Cities and Adaptation to Climate Change*. New York City, united States: Springer Netherlands.
- Rahman, A. (2008). Climate change and its impact on health in Bangladesh. *Regional Health Forum*, 12(1), 16–26. Retrieved from: http://ngof.org/wdb_new/sites/default/files/Climate%20change%20and%20its%20Impact%20on%20Health%20in%20Bangladesh.pdf
- Sanyé-Mengual, E., Cerón-Palma, I., Oliver-Solà, J., Montero, J. I. & Rieradevall, J. (2015). Integrating horticulture into cities: a guide for assessing the implementation potential of Rooftop Greenhouses (RTGs) in industrial and logistics parks. *Journal of Urban Technology*, 22(1), 87-111. Retrieved from: <https://www.tandfonline.com/doi/abs/10.1080/10630732.2014.942095>
- Stewart, I. D. & Oke, T. R. (2012). Local climate zones for urban temperature studies. *Bulletin of the American Meteorological Society*, 93(1), 1879–900. Retrieved from: <https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-11-00019.1>

- Stocker, R., Berinsky, A., Brylinsky, S., Emanuel, K., Jacoby, H., Johnson, B., Kuo, J., Reinhart, C., Rostoum, E., Slinn, A., Supran, G., Suri, T. & Ueland, S. (2015). MIT and the Climate Challenge. Report of the MIT Climate Change Conversation Committee
- Taylor, D. (2009). Biomass burning, humans and climate change in Southeast Asia. *Biodiversity and Conservation*, 19(4), 1025–1042. Retrieved from: <https://doi.org/10.1007/s10531-009-9756-6>
- Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences*, 108(50), 20260-20264. Retrieved from: <https://doi.org/10.1073/pnas.1116437108>
- UN Environment Programme. (2018). Sustainable Development Goals 11: Sustainable cities and communities. Retrieved from: <http://www.unenvironment.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-11>. Visited on 18 August 2018.
- United News Bangladesh. (2016, June 6). Unplanned development works blamed: Greeneries in Dhaka disappearing fast. *The New Nation*. Retrieved from: <http://thedailynewnation.com/news/96068/greeneries-in-dhaka-disappearing-fast.html>
- Voicu, I., & Been, V. (2008). The Effect of Community Gardens on Neighboring Property Values. *Real Estate Economics*, 36(2), 2414–2263. Retrieved from: http://furmancenter.org/files/publications/The_Effect_of_Community_Gardens.pdf
- Weng, Q., Lu, D. and Schubring, J. (2004). Estimation of land surface temperature–vegetation abundance relationship for urban heat island studies. *Remote Sensing of Environment*, 89(4), 467-483. Retrieved from: <https://doi.org/10.1016/j.rse.2003.11.005>
- World Bank (2011). Bangladesh Development Series. The Cost of Adapting to Extreme Weather Events in a Changing Climate. Retrieved from <http://siteresources.worldbank.org/INTBANGLADESH/Resources/BDS28ClimateChange.pdf>
- World Bank Group. (2016). World Bank Group Climate Change Action plan 2016-2020. World Bank, Washington DC. Retrieved from: <https://openknowledge.worldbank.org/bitstream/handle/10986/24451/K8860.pdf?sequence=2>
- World Bank Group. (2018). Bangladesh Disaster Risk and Climate Resilience Program. World Bank, Washington DC. Retrieved from: <https://www.worldbank.org/en/country/bangladesh/brief/bangladesh-disaster-risk-climate-change-program>
- World Health Organization (2010) Urbanization and health. *Bulletin of the World Health Organization*, 88 (4) .World Health Organization. doi:10.2471/BLT.10.010410 .246–245 ,
- Zaman, Q. M. M. U. and Laing, R. (2013). Sustainable Approach to Regenerating Residential Form and Density: Case in Dhaka. *Urban Studies Research*, 2013(1), 1-12. Retrieved from: <http://dx.doi.org/10.1155/2013/783792>

Zeng, X. (2014). Solutions of indoor air improvement in china: A market research for NaturVention Oy (Unpublished bachelor's thesis). Jyväskylän Ammattikorkeakoulu (JAMK) University of Applied Sciences, Jyväskylä, Central Finland, Finland.