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From The Desk of the Editor-in-chief...

"It is mine, it is his; Such thinking is of a narrow minded person; whereas for the liberals, this whole earth is like a family"

Anonymous

A 2016 World Bank report estimated that pollution costs India nearly $ 1.32 billion a year , or nearly 6% of the GDP. No dictionary can do justice to the definition of word "Smog" .For if the teams working on definitions had visited Delhi to experience it , they would have found it tough to elaboratethe 4- lettered word with a suitable definition .The socio, political, economic and Geographical impact on the citizens in National Capital Region (NCR) would perhapscompel any authority to redefine the word.For time and again the automobile industry has always been perceived as the real culpritbut a minute shift to the problem will make us realize that the real culprits are many including farmfires , which took place during winters .

"Stubble Burning" is a method of removing dry stubble from the fields by burning it prior toploughing. Agricultural crops residues are burnt during October and November each year inthe entire Indo- Gangetic Plains (IGP) . This has significant impact onthe Greenhouse gasemissions and aerosol loading . As wind usually blows from West to East , it is basically themajor rice producer Punjab that plays a huge role.For the farmers in Punjab and Haryana , the cost of burning the stubble is much lower thantransporting the stubble to nearby bio refineries, hence the Economic viability of burning thecrop stubble is more appealing than other alternatives. Unfortunately this creates a 'Tragedywhere the sufferers are the citizens of NCRand its immediate neighbours . On a long - term basis , farmers too will face an economicloss because of decrease in agricultural productivity due to environmental degradation andthe health costs will be borne by all.The mindset change requires demonstration of technologically feasible, financially viableand operationally manageable processes of gainfully using paddy straw, and as a rawmaterial in various enterprises. A few options are :

- Utilize paddy residue as livestock fodder and bedding.
- Promote both in-situ and ex-situ composting.
- Adopt rice harvesting machines with concurrent use of specially fitted combines, that have an advanced Straw Management System with turbo happy seeder.
- Scale up use of paddy straw for mushroom cultivation; bracketing for electricity, biogas, biofuel etc.
- Baled bundles and blocks can be used for making of composite boards, fibre reinforced cement or as an admixture in road construction.

Probably , a more permanent solution lies in amending the paddy -wheat crop matrix by substituting paddy with pulses , oilseeds and maize. Though stubble burning practice is unhealthy to the economyyet the question arisesthat are we barking up thewrong tree?

As one of the member of All India Kisan Sabha remarked" Farmers are committing suicide due to debts . How can someone expect a farmer to focus on issues like burning of parali (stubble) ?"

This needs to be addressed and resolved at the earliest so that the pollution levels can be optimally controlled.

Happy Reading

Dr. Sanjeev Bansal
Editor-In-Chief
Amity Journal of Energy & Environment Studies

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Food Waste Management

Roopika Nigam* **Sanjana Sharma****

The research is focussed on the uprising issue of Food Wastage & it's consequence on the food chain, economy, and environment. Every year 1.3 billion tons of food is wasted globally which causes $750 billion worth economic losses and a colossal damage to the environment. Food waste is intact energy resource that ends up rotting away in landfills which emits greenhouse gases in the environment, heating atmosphere thus leafing to climate change. Wastage of food at such a massive scale is a result of negligence on the part of individuals, society, nation, and the world. In this paper We try to expand into various aspects that lead to the wastage of food, as per the various industries.

Keywords: Food waste management, Food wastage, World hunger, Global food security, Environment

INTRODUCTION

In countries like India 795 million, out of the world population of 7.6 billion people, don't have enough food to lead a healthy life or they are undernourished. That is approximately one out of nine people on earth. The reasons can be; firstly, that there is a shortfall in the food produced worldwide or second, there is massive food wastage phenomenon occurring. Looking further into these reasons, today the world is yielding one and half times more for an individual, roughly that is enough to feed close to 10 billion people. Despite this massive number, people across the globe don't have sufficient food, to conclude we can say that the food produced for the consumption of people is being intentionally or unintentionally wasted.

Food waste is an ethical issue of global scale. According to the Food and Agriculture Organization (FAO) of the United Nations, roughly one-third of all the food produced worldwide each year, for human consumptions is either lost or wasted. Every piece of food wasted is an opportunity lost to improve world hunger and global food security. To define food waste, it means food supplies (grains, vegetables, poultry, & meat) or drinks which was predetermined to feed people now lies in landfills as garbage despite it being fit for human consumption. The food thrown is either spoiled or expired chiefly due to economic behaviour, poor stock management and neglect. This is happening is developed, developing and underdeveloped countries with each's contribution higher than the other.

Food Wastage in Developed Nations

We assume that developed nations, like United States of America, Canada or the United Kingdom, don't contribute towards food wastage, but you will be surprised to know that they add to the global food wastage on a massive scale and that too on a per capita basis. The developed nations grow their food in massive quantities due to the high subsidies and flood the market with their produce. With the overflow of the produce, the excess is kept in warehouses. If the food is kept for long-time in these warehouses, decays, therefore, reducing the eatable food. This is further reduced due to the consumer buying pattern and their obsession with aesthetic quality of food. Vegetables & fruits aside from being healthy tend to wilt, brown, bruise or discolour, this is something the consumers do not prefer to buy. Due to this buying pattern and thinking of the consumers, even grocers refuse to stock such imperfect looking food on their shelves or stands. Doug Rauch, the former president of Trader Joe's – an American grocery store - confirmed this pattern by saying, "Grocery stores routinely trash produce for being the wrong shape or containing minor blemishes."

This statement is assuming that this kind of non-aesthetically pleasing produce even reaches the stores, most of the times this produce is either left to rot in fields, hauled into landfills or fed to livestock. In Europe & North America, the per capita waste by

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a single consumer is between 95-115 kg a year. The industrialized countries exhaust 670 million tonnes of food worth US $680 Billion. If the food currently wasted in Europe and North America is to be fed to people then it could feed 200 and 300 million individuals respectively.

Food Wastage in Developing Nations

It is not just the industrialized nations that have a high percentage of food wastage, but now the developing nations are also closing unto these numbers. This primarily takes place due to the poor infrastructure, dysfunctional distribution systems, and corruption. More than half of the produce in these countries doesn't reach the market and even less to the people who reside there. This is causing a loss of billions, children and adults are micronutrient undernourished, and blighting numerous lives. Wastage of food not only has a negative impact on the individuals of the nations but the economy and the environment. Economically, it is a waste of an investment which can reduce the income of a farmer and increase a consumer's expenses. Environmentally, the impact includes excessive emission of greenhouse gases, extensive & inefficient use of water, and minerals thus diminishing the natural ecosystem which we live in. In these nations, the wastage occurs at early stages of the chain and they can be traced back to the financial, managerial and technical constraints during harvest and the basic problem of storage and cooling units. These countries dissipate 630 million tonnes of food worth US $310 Billion. In sub-Saharan Africa, south & south-eastern Asia, the per capita waste by a single consumer is between 6-11 kg a year. In developed nations, more than 40% losses transpire at the consumer and retail levels, while in the developing nations 40% of the losses transpires at post-harvest and processing levels. These losses that take place during harvest and storage converts into lost income for the farmers and high food prices for the consumers.

For example, despite producing 28% of the world's bananas, India is only able to export 0.3% of it internationally. With the help of cold storage units, the number of exported bananas could increase from 4,000 to 190,000 containers thus creating 95,000 additional jobs and benefitting many small-scale farmers.

Food Wastage in India

In a CSR Journal report, it stated that "Indians waste as much food as the whole of United Kingdom consumes." With over 1.3 billion people in a nation like India, millions are still sleeping hungry. In the Global Hungry Index - 2017, India ranks 100 among the 119 countries. Food wastage not only represent hunger, climate change or pollution, but also various glitches in the nation's economy, like inflation. Our traditions and culture play one of the major role in these situations where the policies of the government aren't responsible for such wastages. Here in India, the bigger the wedding, the bigger is the food wastage is expected to be. Today the number of individuals who are 119ungry in Indian are now more than 65 million, which is statistically higher than the population of few countries in the world. Wastage of food can cripple a nation's economy to such an extent that most of us are uninformed. Despite India's largest livelihood being agriculture, there is a struggle to feed its ever-growing population. Regardless of this fact, we are able to grow enough produce to feed each individual but this adequate production of food doesn't guarantee India's food security. As India is a developing nation 40% of our produce is lost during post-harvesting and processing level. The farmers in India do not have money to be technologically ahead of their counterpart in America, so they don't have the facility to store their produce in cold storage, therefore, they end up losing some part of their harvest to decay. Another aspect on which India's farmer lose out is transportation. For example, a farmer in the Vidharbha region of Maharashtra harvests his crops tomorrow, then he stores this produce in an open storage area, now before he is able to sell his produce to the wholesalers which are within 5-7 days of harvest he loses the produce due to decay or infestation of rats. From the field to the market it is a process of at least two weeks thus reducing the produce further. India suffers losses of up to £4.4billion in fruit and vegetables each year due to the absence of effective technologies to keep produce cool. A United Nations report states that India is ahead of China when it comes to wasting food items and both of these nations are the worst culprit of food wastage. An estimate of 230 cubic km of fresh water goes into producing food which is eventually wasted, this water is enough to quench the thirst of 10 crore people each year.

The State of Hunger in India

According to "The State of Food Security and Nutrition in the World, 2017" report, close to 190.7 million Indians are severely undernourished, it refers to 14.5% of the population. Further, in the report, it stated that 38.4% of the children are malnourished and 51.4% of the women in their

reproductive age (15-49) are anaemic. As mentioned above on the Global Hunger Index India ranks 100 out of 119 countries on indicators like – prevalence of stunting in children below 5 years, the mortality rate of children under 5 and proportion of undernourished individuals.

Food Waste & Environment

When you thought that wasting food had no other effect, you were wrong. Food wastage aside from impacting world hunger it also affects the environment. The already scarce natural resources have additional pressure every time food is lost or wasted. Greater the wastage of food along the chain the greater is the impact on the environment because we have to consider the natural resources and the energy that goes waste into producing, processing, transporting and storing the food items.

Once this food waste lands into the landfills it releases a powerful greenhouse gas – methane. This deadly gas with Carbon Dioxide and chlorofluorocarbons heat up the earth's atmosphere, in the end, causing global warming,

Prajal Pradhan, co-author of a research "Food Surplus and its climate burden", explained, "Agriculture is a major driver of climate change, accounting for more than 20 percent of overall global greenhouse gas emissions in 2010. Avoiding food loss and waste would, therefore, avoid unnecessary greenhouse gas emissions and help mitigate climate change."

Generators of Food Wastage

Major generators of food wastage in India are Hostels, Restaurants, supermarkets, individual residential blocks, airline cafeteria, and food processing industries.

RESEARCH METHODOLOGY

This research is quantitative research. It is an exploratory research. These research methodologies will give us an insight into food wastage and help us to develop various potential sources to the wastage and the reasons for the same. Food wastage is quantified by generating statistical data through numerous sources; measurable data is used to formulate the facts and uncover a pattern in research in relevance to food wastage.

Structured data collection methods are utilized in order to deduce the facts related to food waste management in India. Data collection is done from different surveys, paper surveys, mobile surveys, longitudinal studies, website interceptors and systematic observations.

The study will focus on the overview of food wastage in India, followed by major sources causing food wastage and significant reasons which are causing food wastage in our country. Research comprehends the statistical data depicting the percentage of food waste all over the country.

Research elucidates the food waste pyramid. Food waste pyramid is subdivided into two categories – waste management, waste avoidance. Waste avoidance has sub-levels to reduce, feed people in need, & feed livestock; whereas waste management has two sub-levels of compost & 100% renewable energy disposal.

DATA ANALYSIS

Research Aim and Structure

Food waste is the most challenging issue humankind is facing in today's world. Nowadays food systems are extremely inefficient. With largest agricultural sector in the world and population more than 1.3 billion people, India's farming output has a significant impact on global food security.

India produces enough food to feed entire country like Egypt. We are wasting 67 million tons of food every year, according to a government survey. 67 million is more than the national output of a country like Britain. Wastage made every year is more than enough to feed an entire Indian state for a year.

Aim

This paper seeks towards the overview of food waste in consideration of its major sources with a vision of identifying the significant reasons of the food wastage.

Structure

With this objective structure of research mounted in this paper is as follows: Firstly, an overview of global food wastage in India is depicted; Secondly, major area contributing to food wastage are identified; Thirdly dominant reasons accountable for food wastage are set out in the paper; Fourthly statistical data portraying the volume of food wasted and adverse effects of the food waste on our country; Finally, the food waste pyramid.

OVERVIEW OF FOOD WASTE IN INDIA

Food wastage is an alarming issue in India. Canteens, weddings, restaurants, hotels, family

functions, social household spurt out a lot of food. According to United Nations development programme, about 40 % of food which is produced is wasted in India. Roundabout 21 million tonnes of wheat is wasted every year. According to the agriculture ministry, Rs. 50,000 Crore worth food is wasted each year in our country.

According to food and agriculture organization (FAO), a prodigious 1.3 billion tonnes of food is being wasted annually. One-third of the total global food production is wasted, costing world economy around Rs 47 lakh Crore. This formidable acceleration in food wastage is breeding nearly 3.3 billion of tonnes of greenhouse gases, thereby affecting the environment. Wastage of rice is a serious issue as, decaying of rice inhibits Methane, which is most potent global warming gas.

According to National Resource Defence Council (NRDC), 40% of food is not eaten out of all which is produced in the US; whereas in South Asia, India, China 1.3 billion tonnes of food is wasted every year.

In terms of food wastage (agriculture, poultry, dairy) India ranks 7th with the Russian Federation. The foremost reason for being on the lower part of the scale is the utilization of land. In India major chunk of land is utilized in agriculture and this, in turn, explains the wastage of cereals, pulses, fruits, and vegetables occurring in India.

Meat accounts for 4% of food wastage but contributes 20% to the economic cost of wastage. Wastage of fruits and vegetables is 70% of total produce but it, in turn, contributes 40% of the economic cost of wastage. Food loss and waste generated contributes 8% of total greenhouse gas emission.

MAJOR AREAS OF FOOD WASTAGE

In developing countries, most of the food loss occurs in the production chain and it adversely affects the farmer. According to FAO 30–40% of food is lost before sold in the market. This loss occurs due to inappropriate use of inputs, improper post-harvest storage, wretched processing, and transportation facilities. India losses so much of its food wealth as it lacks in cold storage facilities. According to a recent study conducted by IIM Kolkata, India can only offer cold storage to its 10% of its total production.

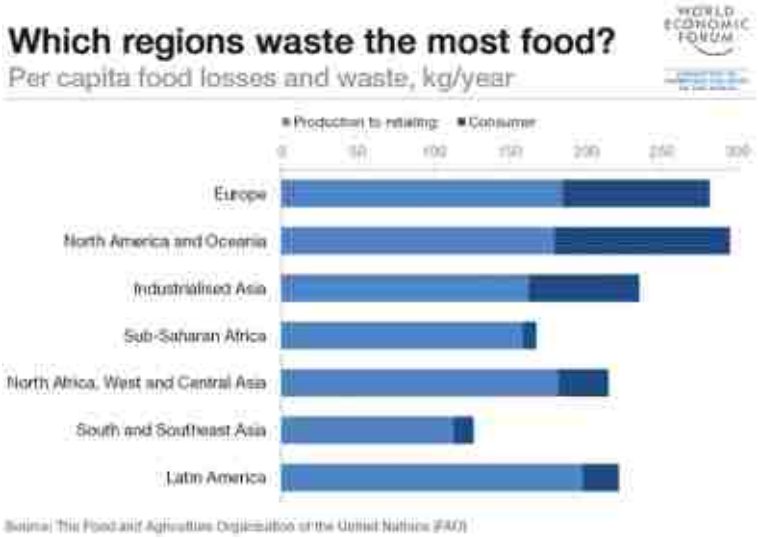
The unfledged supply chain management in India is adding up as a burden to food safety and eventually due to this immature management in supply chain India is projected as a major contributor in food wastage in both pre- and post-harvesting phases. It is recorded that 25% of water goes to drain which is used in cropping food, whereas today millions of Indians are still deprived of fresh water.

Dominant Reason of Food Waste

There are multiple and complex reasons for food wastage across the food value chain.

FARM – Food loss initially starts at the production level. Lower market prices and higher labour cost makes it impossible for the farmer to harvest all that they produce. Despite gleaning and far –to–food-bank to recover this unharvested food, the clear majority is left in the field to be tilled under.

MANUFACTURERS – Customer demands for a wide variety of products cause inefficiencies during this highest recycling level among food processors and manufacturers. Each time production line is



changed it should be emptied and cleaned. Products can require trimming for use in end products, leading to edible parts going unused.

CONSUMER FACING BUSINESSES - Customer demands variety and consistency of food availability that strains inventory management and food purchasing. Higher customer demands for freshness leads businesses to dispose of safe, edible food when it is perceived to past its prime.

HOMES - The demand of variety and lot of food create waste at home. For example, a consumer prefers a different kind of cuisine, but she/he may not have the proper knowledge to repurpose the food and store it properly. Most of the food cooked or bought is unplanned, which leads either to over purchasing and food spoilage. Many families are tempted to buy a lot of food at one time in as they are getting the deal of low-cost per unit. Lack of standardization of Date label, often makes consumer throw away the food which causes 20% of food wastage from homes.

Most Wasted Food

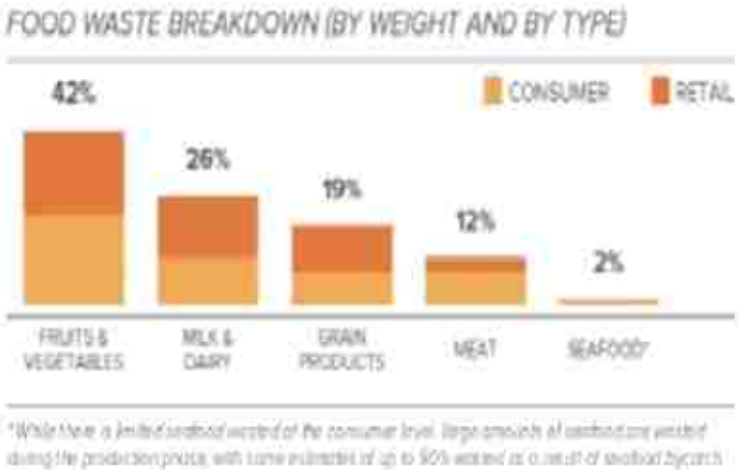
Roundabout 80% of the food waste comes from perishable foods, which includes dairy products, meat, fish, fruits vegetables and some grain products such as bread and other bakery items. Whereas non–perishable food – pasta, canned goods, highly processed shelf-stable products are generally wasted less as they are not spoiled easily. Perishable food often gets discarded because they quickly lose their shelf life and are inexpensive. Fruits and vegetables are least expensive and fastest spoiling food. Seafood and meat are two least wasted and most expensive food type.

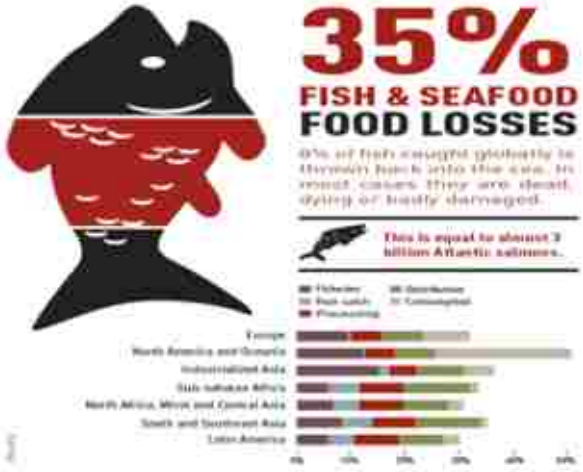
VOLUME OF FOOD WASTED

Different varieties of food are being wasted across the world. Some of them are briefed below:

1. CEREAL

Wastage of cereal is a significant problem as it majorly impacts the carbon emission. Rice wastage is particularly noticeable, as it emits methane while decaying and this methane combine with numerous other gases to pollute the environment.



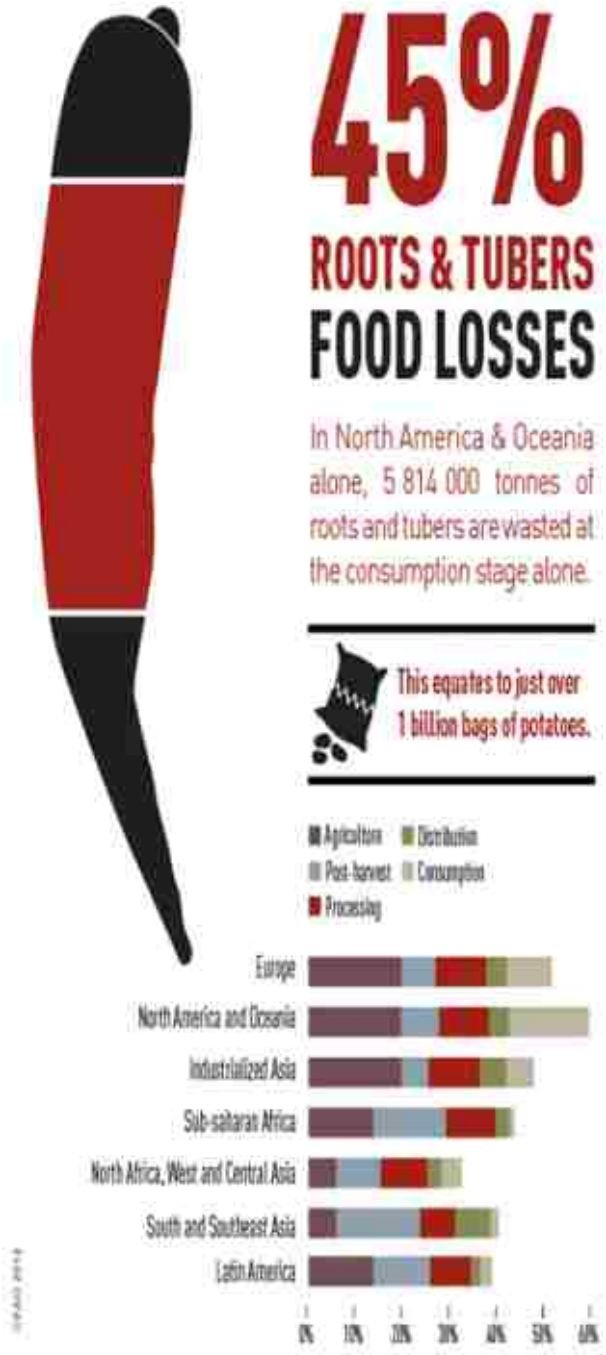


2. DAIRY
3. FISH AND SEA FOODS
4. FRUITS AND VEGETABLES

5. MEAT

6. OIL SEEDS & PULSES

7. ROOTS & TUBERS



ADVERSE EFFECT OF FOOD WASTAGE

Maximum food is wasted at the time of production, handling, storage phase. It is estimated that about 50 % of food is wasted during upstream. And the remaining food is wasted in downstream that accounts for processing, distribution, and consumption stages.

According to FAO middle and higher income group showed food loss waste during downstream waste or consumption phase. Developing countries were more likely lose food at upstream phase due to the shortage of harvest techniques and infrastructure.

Remaining food left is wasted along the food chain. It has an adverse environmental impact; as we take into consideration of energy and natural resources utilized in processing, storing, cooking and transportation.

1. Food waste which lands up in landfill emits a large amount of Methane. These gases cause emission of infrared radiations which heats up the environment and leads to change in climate & global warming.
2. A large amount of fresh water and groundwater is also wasted. By throwing 1 kg of beef we waste 50,000 liters of water. Similarly, we waste 100 liters of water when we pour one glass of milk down the drain.
3. Millions of gallons of oil are wasted every year to produce food which is wasted and goes uneaten.
4. Agriculture chiefly is responsible for alarming threats to plant and animal species which are at stake; estimated by the International Union for Conservation of Nature (IUCN)
5. Home composting diverts up to 150 kg of food wastage per year from local collection authorities.

FOOD WASTE PYRAMID

Waste Avoidance

- REDUCE - This level seeks towards saving food at first place of our utilization. Proper planning should be executed to avoid overproduction scenarios. Better storage conditions should be adopted in order to stretch the shelf life of the product. The alternative market should be discovered in order to keep food in human food chain.
- PEOPLE IN NEED – Surplus food should be directed to organizations and charities which can redistribute the food. This should be done in long run to avoid alarming wastage of food.

- FEED LIVESTOCK- Food which is unfit for human consumption should be feed to livestock in order to avoid wastage. Legally permissible bakery, fruit, vegetables and dairy products should be directed to farm animals.

Waste Management

- COMPOST AND 100% RENEWABLE ENERGY - Unavoidable food waste should be sent for composting for fertilizer production. This unavoidable food is 100% renewable fuel for electricity, heat or transport.
- DISPOSAL – Unavoidable food should not be buried inside the land where environment-friendly alternatives are available. This practice can lead to land pollution which in turn would harm our natural resources adversely.

CONCLUSION

Food waste is a result of throwing away good eatable food before it even reaches the mouths of humans. Food storage is causing the untimely death of approximately 3.1 million children under the age of five across the world. Wastage of food is a real issue faced by the society concurrently with other environment-related issues.

We often see, hear or read of situations which bear the news of starvation-related deaths in India and worldwide while our total output seems to contradict the statement above. Food scarcity in India or worldwide is a man-made problem as nature is pushing its level best to complete the ever-growing demand of humans. It's high time that we start working towards bridging this gap. We should start thinking every time we buy food in excess or eat it on how can we make the most of it without wasting a single drop of water or a single piece of food. It is never too late to rectify a mistake; a moment of opportunity is a year of opportunities. By working together in eradicating world hunger, we can make a humungous difference saving tons of food, millions of money and billions of lives. What difficulties would your firm have in using the enterprise modelling technique if it already has an existing database management system in place? Justify your answer

What difficulties would your firm have in using the enterprise modelling technique if it already has an existing database management system in place? Justify your answer

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E-Waste is Biodegradable or Not

Eva Srivastava* **Devpriya Tomar****

E waste or we tend to say Electronic waste is the growing concern of the planet nowadays. The problem of e-waste has become an immediate and long term concern as its unregulated accumulation and recycling can lead to major environmental problems endangering human health, if not treat properly. In India E-waste containing toxic material that can have adverse impact to human health and environment, if not treated properly. In India e-waste generation rate is 15% increase. Maximum amount of e-waste is recycled and recovered by self-employed sector using basic methods such as open burning and acid stripping method. Electronic equipments, especially computers, are often discardedby the households and small businesses not because they are brokenbut simply because new technology has rendered them obsolete and undesirable. The both methods are harmful to the human and environmental. Many legislation and regulation available in global national level, but no legislation is governed in the informal sector. In this paper we have researched how E- waste could relate to be a voluntary Biodegradable waste.

Key words: E-Waste management, biodegradable waste, electronic equipment's, legislation

INTRODUCTION

E-waste is alternative names given for electronics those have exhausted their productive life. Any thing that runs on electricity/battery or has wire and completed

its life is e-waste [1]. There are various examples of electronic waste as discarded computers, office electronic equipment, devices running on chips, electronics, mobile phones, television, tablets, kitchen appliances and any digital gadget-wastes are considered hazardous to health, as certain components of some electronic products contain materials that spread toxic substances, depending on their condition and density. Electronic waste, e-waste, e-scrap, or Waste Electrical and Electronic Equipment (W.E.E.E) [2][3] describes discarded electrical or electronic devices. As environment is so dynamic in nature due to continuous technological up gradation at such a high rate, many electronic devices become "trash" after a few years of use. In fact, whole categories of old electronic items contribute toe-waste such as VCRs being replaced by DVD players, and DVD players were being replaced by Blu-ray players [4]. Revolution through digitalization followed by the advances in information technology during the past few years has radically changed people's lifestyle. Statistics show that Indian city of Bangalore produces some 20,000 tons of e-waste per year, according to a report by Assocham, the Association of Chamber of Commerce and Industry of India [5]. Among all the metro cities in India, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata and Ahmedabad in E- waste generation scenario. At present, India and China have become the giant global dumpsters for e-waste because of low processing costs and unorganized operating conditions. Although this development has helped the mankind, mismanagement or unorganized waste management system has led to new problems of contamination and pollution. The high quality of technical quotient acquired during the last century has posed a new challenge in the management of wastes. For instance, personal computers (PCs) contain bound components, which are highly toxic, such as chlorinated and brominatesubstances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives. The e- waste problem is solved by starting with educating and changing the habits of the people which results insharing of knowledge and creating awareness. Mostly people are aware about recycling newspapers, bottles, and cans. Almost anything electronic in nature can be recycled by little efforts. So there is a need to have a proper management while disposing or recycling e-wastes. The paper highlights these issues and poses some concrete. From the survey of companies in Delhi Ncr the following data has been collected that talks about the e-waste category. The data table T.1 below is collected through questionnaires circulated in different companies of Delhi Ncr.

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Table T.1 Categorization of E-Waste

EQUIPMENT CATEGORY	%Composition (by weight)
Computer Equipment	72
Telecommunication Equipment	16
Entertainment Equipment	8
Electrical Equipment	4

RESEARCH METHODS

The study was performed on the basis of present E-waste scenario and its problematic site identification along with recommended outline to make out probable solution. The sample area (Delhi NCR region) was selected as an emerging city corporation and Here, structural development following upward trends of IT based companies are being set up. This qualitative and quantitative research was carried out using structural questionnaire survey method. It was consisted of four parts like as part one was contained demographic information, part two was contained E-waste generation approach along with source and quantification, part three was contained E-waste management approach along with the perceptional attitude, part four was contained information on environmental and human health impacts in the aspects of exposure time, place and types of shop. But also certain areas of the nation have been included in the study to know more about e-generation situation in India. Also more of market study, collecting secondary data already available in newspapers, journals, magazines and internet acted as the source of information and important methods for completing this research work.

BIODEGRADABLE WASTE

Biodegradable waste is essentially a kind of waste which is easily soluble in the environment or we may say which could be easily broken into chemical forms and is dissolved back into the environment. Biodegradable materials (garden waste, kitchen waste and waste paper/card, wood) is harmful when not properly disposed off and leads to pollution risk and greenhouse gas emissions associated landfill disposal of waste. Biodegradable waste does not cause any harm instead it is used again and again in different forms in the environment and hence we can say that it is waste which is reused. The Fig1 explains it better. From the Diagram it gets clear that those wastes which easily dissolve in the environment leaving no harmful impact on the ecology leading to their reuse and new energy creation we can say that it is one of the property of Biodegradable waste.

E-Waste as Voluntary Biodegradable Waste

The Fig. 2 shows that how e-waste can be properly disposed off in the environment. If the e-waste is properly disposed and reused in the most efficient manner that most of the energy is not wasted but is utilized again and again in the vicious circle then surely it could be concluded that Biodegradable waste can include e-waste but voluntarily. The table T.2 shows recovery of e-waste is done and the leftover items are being disposed off properly in an environmental friendly method. This is the most important aspect which shows retention of energy by reusing and converting the e-waste into a new form to make it reusable.

Table T.2

OUTPUT	SELLING PRICE	PURCHASER
Cathode Ray tube (CRT)	2-4/per kg	Display electronic Manufacturers e.g.- Television
Metal parts	18-24/per kg	Metal Scrap dealer
Aluminum parts	76-87/per kg	Aluminum Trader
Plastic Parts	7-10/ per kg	Plastic manufacturer or recycler

Case I

Infosys OZONE initiative[7] which an initiative by infosys being healthy, safe and equipped with environmental system. The company has taken effective e-waste management under its scheme EMS(envirnomental management system). This system not only helps in driving the company environmental friendly but at the same time covers the legal issues as well related to waste management. The company has a focused approach to the e waste management policies and practices and is continuously striving for better results. The best Practices followed by Infosys for E- waste management include-

- Waste separation at source
- Plastic waste is sold to bona fide recyclers
- Paper waste is recycled externally by approved recyclers, and reused as note pads
- Hazardous waste such as DG oil, batteries, etc., are given only to PCB-approved agencies
- Certain e- components are given to get repaired and fixed to be used again
- Scrap is sold to authorized scrap dealers
- Suppliers are engaged in discussions to eliminate the use of non-bio-degradable packing material such as thermal. The company pushes their suppliers to use more environment-friendly packing material.
- Use of Degradable plastics and electronics.

Case II

Wipro is highly environmental conscious and therefore it is continuously striving to attain its goal of environmental friendly work processes- waste management is one of the crucial issues being put by the IT giant Wipro. In one of the clash with Greenpeace association Wipro said "The issue being highlighted by Greenpeace is about the disposal of scrapped computer by the owners and users of computer and electronic goods. This is a larger issue and involves all the users and owners of computers, the entire installed base of computers and all the vendors/manufacturers in India" [8].This stand of Wipro is possible only because of their stiff policies on disposal of e-waste here they have a proper segment and a department to handle all the technicality related to e- waste and try to maximize their reuse to the fullest. Wipro also started offering e- waste disposal services to its customers from 2006 onwards.

Case III

Tata Consultancy Services one of the largest IT based company in India is strictly following environmental friendly methods, to keep the environment safe and clean. TCS has adopted the policy (OHSMS) Occupational Health and Safety Management System. TCS, a leading Indian IT company is committed towards 100% environment friendly disposal of e-waste which gives its E-waste only to the E-waste recyclers / handlers which are certified by the Ministry of Environment & Forest/ country specific regulator bodies [9]. TCS has also extended the life cycle of computers / hardware from 3 years to 5 years and procures computers / hardware only from USEPA / similar Energy star labeled vendors [9]. TCS is also committed to follow the WEEE Directives for E-waste handling [9]. Needless to say, TCS follows all the rules and regulations. TCS' waste management practices are centered on reduction in generation, segregation at source, and reuse and recycle wherever possible. Reduction at source is the most important lever, and we are pursuing this by raising awareness and motivating action towards sustainable waste management. While municipal solid waste is the predominant type of waste generated, TCS also generates electronic and electrical waste (e-waste), and a relatively smaller proportion of hazardous waste such as lead-acid batteries and waste lube oil.

VOLUNTARY E-WASTE IN NEW FORM

US researchers have developed a flexible, organic and biodegradable semiconductor that can help to cut the mounting pile of global electronic waste, a research published said [10]. Stanford engineer Zhenan Bao and her team created the flexible electronic device that could easily degrade just by adding a weak acid — vinegar, said the Proceedings of the National Academy of Sciences' paper [10]. The team working in the Stanford University has developed the degradable electronic circuit and a new biodegradable substrate material for mounting electrical components. Electronic components used in electronics such as computers, televisions, laptops etc. are usually made of gold. But for this device, the researchers created components from

iron. Bao noted that iron is a very environmentally friendly product and it is nontoxic to humans [10].This substrate supports electrical components, flexing and molding to rough and smooth surfaces alike [10]. When an electronic device is no longer needed, the whole things can biodegrade into nontoxic components. In Bao group, they tried to mimic the function of human skin to think about how to develop future electronic devices. Bao, a professor of chemical engineering and materials science and engineering, said in a statement. "We have achieved the first two (flexible and self-healing), so the biodegradability was something we wanted to tackle" [10]. Previous material designed by Bao's team could bend and twist in a way that could allow it to interface with the skin or brain, but it couldn't degrade, said the Stanford release. This theory and scientific research gives the platform where in future E-waste could surely be considered as biodegradable waste and its hazardous limitations could be removed to the maximum extent. This is a beginning of a new concept which is only possible when there is a follow up approach towards proper E-waste management system.

CONCLUSION

The Biodegradable waste holds the property of being in the environment in different forms of energy. In Biodegradable waste the energy is not wasted but is retained and continuously flowing in a cycle. The scientific law says "Energy cannot be created nor be destroyed" which means that whether a product is in its waste form the energy is not destroyed, energy is still there so to retain that energy is what is required in the E-waste management system. From Fig1 and Fig. 2 it gets clear that if one of the properties of Biodegradable waste is inherited in E-waste it can be categorized as Voluntary Biodegradable E-waste. For this to become an evident and full fact more scientific researches needs to happen. Moreover, most of E-waste is composed of Cu, Al and Fe, attached to, covered with or mixed with various types of plastics and ceramics, which are very hazardous and are not easily disposable in the environment. For that Scientists are continuously striving for innovation and new inventions to bring the waste form into a new era where E- waste could be properly disposed off and the environment is free from toxic substances.And just in time, the biodegradable circuit board arrives, can it solve the problem? While transient electronic components currently exist, putting all of these parts together into an entirely biodegradable circuit board has yet to be conquered, until now. A group of scientists at the University of Illinois Urbana-Champaign Frederick Seitz Materials Research Laboratory set out to create a fully functional PCB that disintegrates when exposed to water [11].

The Biodegradable System

The scientists determined to create a working circuit board system that could do the following:

- Measure variations in room temperature, and report that data back to an external recording system through a wireless signal.
- The data would need to be very accurate when compared with conventional temperature measurement systems.
- The circuit board would also need to be completely biodegradable, leaving only components and trace materials after being exposed to water.

The results were pretty amazing. This biodegradable circuit board was able to record temperature results that were so accurate that they aligned almost perfectly with temperature reports from a local weather station during a 24 hour period. And when the PCB was immersed in water for only 10 minutes, it completely disintegrated, leaving behind only the components and biodegradable materials. And the best part? The entire thing was flexible. So all this comes to a conclusion that scientists are trying to achieve E-waste as biodegradable waste through new experiments and as researchers it is important to explore more over this theory and deliver it to the world. So the theory of E-waste as voluntary biodegradable waste could be explored by more researchers in the coming time.

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Green Wall: The Vertical Planting System

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The subject of this report has been drawn consideration and give thinking of the answers for one of the bigger issues we confront overall today. Acknowledging and understanding the moving atmosphere changes each year, the reality that the CO2 levels are getting higher, and, in a few nations, the air is ending up so contaminated that it is difficult to try and inhale it, there must be some basic changes made in our regular daily existence and environment.

A standout amongst the best arrangements, in the battle of environmental change, would be 'Green wall' or 'vertical planting frameworks'. Late examinations and specialized reports, that I will say in the main segment, argument the significant advantages of these living walls. Articles and e-books expound on and clarify how green walls add to the earth by cutting air contamination in urban areas, decrease the urban warmth island impact, enhance the structures vitality productivity and also how they impact human wellbeing.

The aim of this research is to explain to the reader the importance of implementing vertical planting systems in a construction of a building, answering critical questions such as:

1. How can green walls fight global warming?
2. What are the environmental advantages of green walls?
3. How can green walls influence human health?

Keywords : Global warming, green walls, human health influences, vertical planting

INTRODUCTION

Rationalization of choice of subject and professional revelence

The reason of decision for this subject – "Green Walls as Vertical Planting Systems", has risen because of the current environmental change occasions, to attract attention to worldwide issues, for example, nursery impact and to demonstrate vertical greenery enclosures can be one of the main answers for battle air contamination, environmental change and a worldwide temperature alteration. Considering that vertical greenhouses are not yet generally utilized as a part of the building business and that the development advertise contrasts from nation to nation, many organizations confront troubles in discovering evidence that green walls have useful incentive to the economy. Then again, certain plants hold broad properties adding to the earth, human wellbeing and their prosperity. They, in their exceptionally nature, have been furnishing us with fundamental sources all through the historical backdrop of humanity.

Delimitation

Considering that this dissertation is based on green wall influence to the environment and human health, certain data will not be mentioned in the report in order to limit the field of study. The main section of this dissertation will be focused on specific areas that are important for the student as well as for the chosen subject:

- What are the main benefits of a green wall construction? (Various environmental and human health benefits, building protection and energy efficiency, contribution to the economy and the society)
- What are the main layers of a green wall system?
- The importance of weather conditions to sustain plantation life on a wall
- What are the benefits of green walls enhancing the buildings energy consumption levels?
- How can green walls fight air pollution, thus improving the urban environment? (Cutting air pollution, reducing urban heat island effect, improving air quality);
- Improving indoor air quality as well as human health
- How can green walls benefit urban design and

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the society? (improving the overall urban design and the city's reputation to environmentally friendly solutions, help companies with marketing);

To sum up, this report will concentrate on the argumentation of how green walls add to the earth, human wellbeing and the structures vitality effectiveness. It will comprise of research concentrated on how green walls, as vertical planting frameworks, can go about as an economical arrangement in urban communities of huge population.

Theory in use

The theory used in this report is based on various data gathered from E-books, case studies, scientific articles and technical reports. The research collected from different case studies and technical reports will be used for comparison and examples, confirming that green walls hold beneficial properties to a sustainable environment, human health and the buildings energy efficiency.

RESEARCH METHODOLOGY

The whole foundation of the paper will consist of a literature review method in order to understand and answer the problem statement as well as the previously mentioned supporting questions. As the basis of the report, literature review method will consist of an analytical analysis of the two types of empirical data:

- Qualitative data
- Secondary quantitative data

Qualitative data is an exploration strategy in view of other person's opinions and thoughts about the point included. It will be utilized for portraying and depicting green walls not as vertical planting frameworks from a specialized perspective, however as opinion based verification that living walls can be a resource for the earth. Then again, quantitative and secondary quantitative data will be utilized as the principle wellspring of research containing numbers, charts and development points of interest in light of certainties and demonstrated techniques as practical examination.

To satisfy the requests for this report and to achieve the best outcomes, all the assembled information will be separated and surveyed by the understudy from an outside perspective, giving an unbiased point of view to the principle area of the included subject. This technique for social event information will be arranged in the report in such a path in this way, to the point that both the understudy and the peruser will have a reasonable comprehension of the field of earth neighborly arrangements and in addition featuring the rising issues on a worldwide scale.

GREEN WALL- VERTICAL PLANTING SYSTEM

Green walls are otherwise called a 'living walls', 'vertical greenery enclosures', 'green façades' or 'Vertical Vegetated Complex Walls' (VCW) either detached or part of a building, that have a vertical course of action of living plants normally expelling the poisons and other unfortunate contaminants from the air that we relax. The most established known arrangement of a green wall might be found in the antiquated city of Babylon, one of the seven marvels of the world, where vertical and hanging gardens were an extraordinary wellspring of pride to the general population. They trusted that plants in their extremely nature served the earth and its tenants by being a fundamental wellspring of sustenance, safe house and dress. Green walls are an antiquated idea and can be a total biological community or a basic design of plants. In around 600 B.C. they have been acquainted in structures with clean urban situations improving the harmony between encompassing environment, atmosphere, body and soul. It is imagined that such a technique for executing manor life into structures is as old as urban areas themselves.

Although inexperienced walls and inexperienced facades have a similar look from the surface, it's helpful to differentiate their variations. inexperienced walls have growing media supported on the face of the wall (integrated within the construction) whereas inexperienced facades have soil solely at the bottom at the wall or within the ground belongings mounting plants grow upward on the face of the wall, making a inexperienced, vegetated façade. Living walls have seen a recent surge in quality. Of the ninety large-scale out of doors inexperienced walls listed in a web info provided by greenroof.com, peaking from the year 2001 to 2015.

In 1938 Stanley Hart White, a teacher of Landscape design made a patent for the primary known Vertical Garden, or "Vegetation-Bearing Architectonic Structure and System". Tragically, around then, vertical greenhouses were just taken a gander at as a calculated thought, infrequently

utilized as a part of any building venture for the absence of present-day innovation and materials.

Presently, the greater part of the total populace lives in mechanical urban areas where solid structures rule. Be that as it may, with the push for more beneficial conditions the world is swinging back to green and originators, engineers and organizers are including plants as an approach to enhance existing infrastructural style.

Green wall construction

While S.H. White created the foundation for vertical planting systems, Patrick Blank – a French botanist is known to be the first person to establish a modern day concept of plantation use in a wall construction. Although Blanc did not invent the vertical garden, he is now a famous botanist for modernizing and popularizing the garden type. He described his vertical planting systems as follows:

"On a heap bearing wall or structure is set a metal casing that backings a PVC plate 10 millimeters (0.39 in) thick, on which are stapled two layers of polyamide felt every 3 millimeters (0.12 in) thick. These layers emulate precipice developing greeneries and bolster the underlying foundations of many plants. A system of channels controlled by valves gives a supplement arrangement containing broke down minerals required for plant development. The felt is drenched by narrow activity with this supplement arrangement, which streams down the wall by gravity. The underlying foundations of the plants take up the supplements they need, and abundant water is gathered at the base of the wall by a drain, before being re-infused into the system of channels: the framework works in a shut circuit. Plants are decided for their capacity to develop in this kind of condition and relying upon accessible light."

Local difficulties characteristic in the site's common highlights and also daylight, wind, dampness, and soil display development challenges in green wall and green wall framework plan. Fruitful green wall require joint effort amongst authorities and scene draftsmen. Innovation and agriculture necessities are additionally cutting-edge, yet encounter prompts fruitful green wall ventures.

Types of Green walls

Green Wall has been isolated into two primary classes: green façades and living wall; nonetheless, the idea of a green wall can be stretched out to a more extensive scope of frameworks: urban fences, stone wall, green screens, live window ornaments and living wall.

Green Wall, where the vegetation develops on or inclines toward vertical surfaces, can be actualized outside or inside on a vertical surface, from building façades to limit fences or even unsupported structure. They can be incorporated into new development or effectively remade to existing structures.

Vertical greenhouses can fluctuate impressively in development:

Green Facades Green façades are made of climbing plants developing on a wall either with no extra foundation, or with the utilization of stainless steel or wooden trellis, meshwork, or cabling, as plant bolster. This development classification can be isolated in a few subcategories:

- Trellis framework. A progression of wires or links is connected to structure, permitting the climbing plants to grow up the links to make a plant screen/wall. Can be connected to the building envelope or can be unsupported.
- Modular trellis board framework. An unbending, light weight, three-dimensional board produced using welded steel that backings plants both on the external façade/basic framework and the board profundity. This framework is intended to keep the green exterior off the wall surface with the goal that the plant material can't join to the building.
- Cable and wire-rope net framework. It utilizes either links or potentially wire net. Links are typically intended for more quickly developing climbing plants, while wire-rope nets are utilized for supporting slower developing plants that need bolster at nearer interim. Both frameworks utilize high malleable steel links, stays and supplementary gear.

The underlying foundations of the plants can begin from the dirt at the ground-floor level or from an extensive soil compartment that runs parallel to the wall giving space to the plants, otherwise called the "living shade" wall.

- Living/Green wall. Living wall are as of late grown, yet most regularly utilized totally counterfeit frameworks, utilizing nonstop or particular, planted-up, units. Developed from pre-vegetated boards, vertical modules or planted covers (vegetated tangle wall) that are

settled to the auxiliary system or to a wall.

- Modular green wall. Comprise a matrix of particular boards that hold developing media to help the plants. Normally pre-developed, giving a moment impact after establishment .
- Vegetated tangle wall. This framework, spearheaded by Patrick Blanc, is made out of two layers of manufactured texture with pockets loaded with the plants and developing media.

Any plant species can be developed on a living wall framework. Ordinarily, the main limitation is the heaviness of the develop plant; some felt layers frameworks have been appeared to help tree species. Indoor wall are generally planted with tropical species because of the consistent gentle temperature and the absence of light; while outside wall are more limited to provincial plants. Living wall are now and again alluded to as "vertical greenhouses" when they are utilized to develop herbs or potentially plants delivering vegetables or natural products. When developing herbs, the green wall is generally called a "herb wall".

Contingent upon the framework and the producer, units are either pre-developed in nursery (vertically or not) before establishment or planted nearby once introduced.

- Interior green wall. Inside living wall can be developed from any of the past frameworks making a crisp and solid condition. Intended for inside purposes, called the Bio filtration framework (Bio-wall). Introduced as floor to roof include wall they make visual effect anyplace and can change dull, utilitarian halls and holding up spaces into appealing indoor greenhouses. Due to the circuitous daylight and ventilation, tropical plants are the most regularly utilized vegetation arrangement by cleaning the air, adjusting the indoor mugginess and lifting up spirits.

Weather dependancy

As beforehand specified, climate conditions are a standout amongst the most imperative angles that should be taken in thought amid the outline period of the undertaking. There is a motivation behind why diverse plants can withstand certain locale conditions than others. It is critical to investigate and comprehend the atmosphere conditions, for example, air temperature, relative stickiness, wind speed, sun powered radiation, overcast cover and month to month precipitation for outside vertical planting frameworks and plant species. Plants must be painstakingly chosen so the wall can adapt to the climate in one specific area. For example, the developing time of green wall plants in central, completely muggy zones can be near year-round, yet a similar developing period is just a couple of months for mainland zones with frigid winters.

Dissecting the quantity of ventures developed to-date, the biggest level of establishments are in a year-round warm atmospheres. Albeit the greater parts of the tasks are outline in a warm, tropical atmosphere, it can be exhibited convincingly that they are not by any means the only conditions that can bolster outer green wall. Green wall can grab hold in a scope of atmospheres, given cautious plant determination, façade introduction and water system procedure.

Furthermore, it is likewise critical to characterize the "plant strength zones" for certain atmosphere conditions as these are dictated by geographic zones and plant capacity to withstand the normal least temperatures in that zone. The "Farming Research Service" has characterized 13 toughness zones that compare to plant choice, the most reduced number are the plants that flourish in extraordinary frosty conditions. For instance, plants portrayed as "strength zone 8a" (Copenhagen, Denmark) can withstand winter temperatures of up to -12 °C.

By looking at the ventures of "The International Greenroof and Greenwall Projects Database" fluctuating from the most minimal in London with 10.2 °C yearly temperature and the most elevated in Bangkok, Thailand with 28.5 °C yearly temperature, and in the meantime, urban communities like Milan with the normal yearly temperature swings from 0.3 °C to 23.1 °C we can infer that living wall are achievable in areas with normal critical temperature variety, depending from the right plant and framework decision.

Green wall introduction and decision of plant species are likewise affected from the measure of light and sun powered radiation they pick up in certain topographical regions. While all plants require sunlight and some daylight, an excess of direct sun powered radiation for some plants can be dangerous. In the book "Green Walls in High-Rise Buildings" 18 green wall ventures were broke down in various land regions where Bogota, Columbia got the most normal measure of daylight of 7.2 hours day by day. In spite of the fact that overcast cover

negate the measure of sunlight based vitality that really enters to ground level, London is resolved to get minimal measure of daylight day by day.

The measure of precipitation in various atmosphere zones is imperative when choosing how much water system and how regularly certain green wall framework may require. Plant decision is additionally needy from the measure of precipitation as the two ought to be adjusted between each other. Each task ought to be usual to mirror the neighborhood atmosphere conditions and selection of plants.

Wind speed and the green wall introduction is likewise a fundamental factor to be resolved at the outline period of the venture. Plants are for the most part extremely delicate to wind and can be forever harmed on the off chance that they are not acclimated to it. In any case, the contextual analyses in the book "Green wall in High-Rise Buildings" have demonstrated that outside vegetation can be bolstered in areas with normal breeze rates of up to 4.4 meters for each second. Since a few tasks have been produced in tropical areas, they have been intended to get incidental hurricanes. Moreover, makers, installers and architects must consider such occasions and designer green wall frameworks so they withstand fast breezes.

Each zone has its own particular miniaturized scale atmosphere and climate reliance for living wall is a vital angle to be taken in thought while picking the wall frameworks and kind of plants. Each green wall venture must be deliberately thoroughly considered and arranged at the plan stage with the goal that they get the slightest harm conceivable amid excellent atmosphere changes or occasions, for example, tropical storms and different tempests. It is demonstrated that green wall frameworks, with watchful arranging, can be widespread and created in warm, tropical land territories and in addition in colder, more northern nations. See informative supplement 5-6 for a relative table of contextual analyses in various areas.

Benefits of vertical planting systems

Vertical planting systems can offer a wide variety of multiple benefits spanning from public to private and design advantages. These benefits may vary depending on different factors such as geographical location, its climate, building geometry and orientation, plant species, green wall components, type of systems and their size.

The most important benefit of a vertical planting system is their ability to improve the surrounding environment. Through the process of photosynthesis plants transform carbon dioxide, water and solar radiation into oxygen and glucose that are the most important elements for life on this planet. In large cities with high rise building and immense areas of concrete, vegetation is scarce compared to this scale, thus resulting in less oxygen production. In addition, numerous urban sources emit carbon dioxide and other greenhouse gases into the atmosphere, resulting in larger air pollution than the plants can handle. Thus, it is important to bring vegetation into the oxygen-deprived areas of cities and improve air quality.

Vertical planting frameworks can offer a wide assortment of numerous advantages crossing from open to private and configuration favorable circumstances. These advantages may change contingent upon various factors, for example, geological area, its atmosphere, building geometry and introduction, plant species, green wall parts, sort of frameworks and their size.

The most vital advantage of a vertical planting framework is their capacity to enhance the encompassing condition. Through the procedure of photosynthesis plants change carbon dioxide, water and sunlight based radiation into oxygen and glucose that are the most essential components for life on this planet. In expansive urban areas with tall structure and monstrous territories of solid, vegetation is rare contrasted with this scale, consequently bringing about less oxygen generation. What's more, various urban sources radiate carbon dioxide and other nursery gasses into the air, bringing about bigger air contamination than the plants can deal with. Consequently, it is essential to bring vegetation into the oxygen-denied zones of urban areas and enhance air quality.

Public Benefits

Of all the plan and innovative alternatives open to building planners, it is difficult to question that there are systems that would have a more noteworthy effect, earth, socially and tastefully crosswise over both building and urban scales than actualizing green wall in huge amount in our urban areas.

Green wall give stylish variety in a domain in which individuals complete their day by day exercises. Various examinations have demonstrated that vegetation usage can enhance human wellbeing and their mental prosperity.

With expanding number of vehicles, aeration and cooling systems and modern outflows have significantly risen the levels of nitrogen oxides (NOx), Sulfur oxides (Sox), unpredictable natural mixes (VOCs), carbon monoxide (CO) and particulate issue. These raise temperatures in present day urban situations however vertical planting frameworks diminish these poisons noticeable all around and supplant a portion of the mechanical instrument, for example, conditioners, as indoor green wall go about as regular conditioners themselves.

On a terrific scale, vegetation enhances the general state of the earth. Plants catch the debasing particles on their leaves, directing the temperatures and fighting air contamination. Green wall can go about as air cleansing frameworks lessening poisons noticeable all around and, in this manner enhancing the general wellbeing of individuals.

Aesthetic improvements

It is the most obvious advantage of vertical planting frameworks conveying shading and life to the building envelope. Architects utilize green wall as regular craftsmanship articles to grasp structures. Different plants, with their novel hues and surfaces can be skillfully utilized as a live workmanship medium that progressions its shade as per the season. Utilizing green wall can be an awesome advantage for the task fashioners and customers as they pull in more consideration than the very recognizable building structures glass or solid veneers.

- Creates visual intrigue. Green wall wear not simply go about as normal channels and insurance for the earth and structures, they likewise enhance the general plan of the building, making it all the more speaking to the eye. Living wall can include significant incentive for the building: it can be showed into something lovely illustration consideration, or it could be utilized as methods for promoting. Green wall are not all that normal yet, so individuals tend to see them when they see it, seeing everything about the plan and at last, respecting it overall.
- Hides unattractive highlights. Green wall can be utilized as a methods for covering undesirable highlights, for example, auto parks, porches and walkways making a more characteristic delight search for the building. Going about as a moment layer for the building envelope, green wall can likewise cover up undesirable auxiliary components like segments, steel or solid structures and other. This component of green wall can enable creators to discover arrangements on the most proficient method to enhance theaesthetical look of the structures and additionally fortify the bond between the structure and nature.
- Expands property estimation. As beforehand said, green wall are extraordinary advertising devices that can be utilized to advance an organization's green picture. When introducing green wall it could pull in clients by seeing the organization's logo and in the long run winding up with the item the organization is offering. A living wall can build the property estimations of homes and organizations. By essentially having plants in and around a building can expand land esteems by up to 20% [Ref 1]. Also, it has been demonstrated that having living wall in retail shops, shopping centers, eateries, bistros, bars and different organizations, the quantity of clients increments. Certain examinations have appeared expanded inhabitance rates at inns that haveexecuted green wall than those without vegetation. Individuals need greenery, it influences them to feel more casualwhat's more, tranquil, and this paves the way to remaining longer in the foundation, accordingly spending more cash.
- Provides intriguing unsupported auxiliary components. Not exclusively can green wall be actualized in officially standing structures, however they can go about as self-supporting structures, mimicking a wall with no extra materials required. They bring many advantages into the zone sustaining the encompassing nature and in addition bringing down the building effect to the earth. A decent case is "The Rubens Hotel" in London, United Kingdom. This entrancing 350 square meter living wall has an aggregate of 22 distinctive local plant species that bloom consistently. It gives untamed life natural surroundings, pulling in bug pollinators – drawing honey bees, butterflies and fowls, which are urgent in light of the decrease in the honey bee populace. The plants have been picked with regular shading changes as a main priority, going from blue to pink, purple, white and yellow. The structure was intended to be as earth agreeable as could reasonably be expected, limiting the effect to the encompassing range and in

addition keep the inn cooler in the late spring with the extra protection and shading it gives.

Reduction of urban heat island effect

The Urban Heat Island (UHI) impact, created by the temperature distinction amongst urban communities and wide open, has turned into a difficult issue in numerous cutting edge city. Urban communities wind up plainly more smoking since they have many warmth causes, for example, vehicles, modern generation structures, mechanical hardware and building materials with hard and intelligent surfaces, which reflect warmth to the earth where it is then caught in limit urban ravines. Also, the UHI impact increments when utilizing mechanical aerating and cooling to cool building, obviously causing more air contamination and ozone depleting substance emanations to the environment.

The Urban Heat Island impact can be controlled while bringing more vegetation into urban areas through vertical planting frameworks. Plants can help make a cooler microclimate by retaining warmth and lessening outside air temperatures, expanding mugginess levels, protecting structures and territories from coordinate sun and wind. Green dividers can assist oversee UHI impact with these useful highlights:

- Promotes normal cooling forms. The utilization of vegetation into urban situations create regular cooling procedures, for example, photosynthesis and evapotranspiration. In hotter temperatures, when a building envelope is secured with vegetation, for example, green dividers, the encompassing air temperature can be diminished, which not just prompts vitality reserve funds for cooling building insides, yet additionally to the bringing down of the UHI. In 2006 Alexandri and Jones [Ref 2] had led an investigation utilizing 2 green rooftop and 2 green dividers as a trial to demonstrate UHI impact delimitation utilizing vegetation. They performed reproductions making a manufactured gorge angle proportion and atmosphere finding that utilizing vegetation could lessen the air temperature of up to 10 °C for hot and parched atmosphere.
- Decreases temperature in urban regions. Urban warmth islands are regions (typically vast urban communities) where the temperature is higher than the encompassing territory of the city. As already said, this is caused via ventilation systems, black-top streets, vehicles and the overall public. Vegetation can lessen the temperature in these urban regions by their evapotranspiration process* and shading. At the point when green dividers are executed on a building envelope, they go about as a cooling technique as well as supplant the structures region as a more manageable arrangement, other than a similar glass, concrete or other building materials those assistance increment temperatures in urban ranges.
- Breaks vertical wind stream by cooling the air as it backs off. Another advantage of green dividers that assistance lessen the urban warmth island (UHI) impact is the property of regular hot air control. The laws of thermodynamics reveal to us that warmth moves from ranges of higher temperatures to zones of lower temperatures. Warmth can go up, down, right or left, contingent upon the temperature contrasts. Warm air rises when it is encompassed by cool air in light of its lower thickness. So thickness contrasts are the fundamental factor causing the development of hot air. Green dividers assimilate the encompassing hot air through the plants photosynthesis and evapotranspiration, making lower thickness around the structures envelope. Hot air caused by the asphalts and different elements said above normally move towards the cooler ranges with bring down thickness in this manner finishing the cycle. This marvel of hot air development to bring down thickness ranges is called stack impact.
- Provides shading. Living dividers are a generally new innovation that can likewise be utilized effectively in our inexorably thick urban conditions. The additional greenery can bring down encompassing temperature and direct the unforgiving idea of numerous urban structures. Plants give regular shading that pave the way to lessening of temperature of a building's outside divider, in the long run decreasing the warm conductivity of a building envelope and enhancing the structures vitality effectiveness. Vertical planting frameworks ensure the divider development behind the plant layer from bright radiation that can cause material crumbling. By bringing down day by day temperature changes, plants help decrease inward worries in building materials, which can prompt breaking and untimely maturing. On extraordinary days, the uncovered outside

divider temperature can change between - 10 °C and 60 °C while the temperature of a living divider secured fabricating envelope contrasts just between 5 °C and 30 °C.

The urban heat island (UHI) effect is a serious phenomenon that causes damage to our environment and well-being. Through the means of environmentally friendly solutions such as green wall implementation into the building industry the level UHI effect could be managed by lowering the temperatures in the urban areas. The vegetation on green walls help cool and ventilate the surrounding areas of a building, providing more healthy and habitable living conditions.

Improved exterior air quality

Worldwide pollution may be the most dreaded occasion that could prompt an appalling planet. Numerous cutting edge urban areas experience the ill effects of air contamination that can prompt various human sicknesses and can possibly quicken the decay of building materials. Late examinations and articles demonstrate that air contamination is the reason for all the worldwide occasions, for example, atmosphere changes and an unnatural weather change. What's more, air contamination is most hazardous to human wellbeing prompting unchangeable side effects.

Green dividers have many points of interest spreading over from upgrading building appeal to enhancing the urban warmth island impact, yet the most useful part of living dividers is the capacity to expand the breathable air quality.

As specified in the book "Green Walls in High-Rise Buildings", a German report, led by Minke and Witter in 1985, demonstrated that a road without trees had air contamination bookkeeping to 10,000 – 20,000 soil particles for each liter and a road loaded with trees had just 3,000 earth particles for every liter.

In 2012, a later displaying examination was completed by an organic chemist Thomas Pugh and his associates, where they broke down the impact of vegetation on air science and air contamination and in addition the execution of plants in the urban framework and the administrations it gives. At the Karlsruhe Institute of Technology in Germany, T. Pugh and his group made an automated model of a vertical planting framework with non specific vegetation in a Western European city. In the trial, they made an engineered "road gorge" encompassed by vegetation (see picture 16). They recorded diverse substance responses that depended on an assortment of variables, for example, wind speed and building position. One of Thomas Pugh associates, Prof. A. Robert MacKenzie watched:

"The advantage of green dividers is that they tidy up the air coming into and remaining in the road ravine. Planting more green dividers deliberately could be a generally simple approach to take control of our nearby contamination issues."

As the examination states, both nitrogen dioxide (NO2) and particulate issue (PM) store rates shift appropriately by the encompassing sorts of surfaces. Plants retain substantially higher rates of NO2 and PM than those of hard, fabricated surfaces. Already directed investigations demonstrate [Ref 6] that the testimony of vegetation can enhance urban air quality up to 5%, in any case, these examinations don't account the coaction between the urban condition and vegetation, particularly the time traverse the air stays in the road gorge.

The investigation, regulated by Thomas Pugh and his partners, demonstrates that expanding the precipitation by the plant leaves of vegetation in road gullies can lessen urban contamination in those gulches by as much as 40% of NO2 and 60% for PM. This determination demonstrates to us that a solitary road gully, or a many green divider usage in city-sized zones can give noteworthy air quality upgrades. Moreover, plants keep on offering noteworthy advantages in the decrease of air contamination, regardless of the possibility that the reason for it is expelled from city roads.

Hence, circumspect utilization of green dividers on building envelopes can make a proficient, expansive scale air contamination separating frameworks, yielding fast and managed enhancements in road level air quality in thick urban regions. By an issue concentrated utilization of vertical planting frameworks in urban territories, vegetation can enhance the general air quality, avert dangers to human wellbeing and battle the gauge of current atmosphere conditions.

Private benefits

On the size of individual structures, the generous advantages of green wall incorporate the diminishment of structures vitality utilization, in this manner making it more reasonable for the encompassing condition. By protecting or shading the building's façade, green wall help to lessen the utilization of warming and cooling working

frameworks and additionally help to expand the tenant's fulfillment and his/her efficiency by interfacing the occupant straightforwardly to nature, where the plants channel the airborne poisons and enhance the indoor air quality. What's more, green wall likewise go about as regular layers of assurance for the heap bearing and protecting development components of a building. Living wall shield outside completions from the UV radiation and temperature vacillations that wear out materials and in addition advantage the seal or air snugness of entryways, windows, and cladding by diminishing the impact of wind weight.

IMPROVED ENERGY EFFICIENCY

Plants have multiple benefits for improving the buildings thermal performance. Green walls act as natural insulators, covering the building's envelope and, accordingly, reducing the heat loss in cooler climates. In hotter climates, green walls help to reduce heat gain by shading the building's exterior wall and reducing heat conduction through its envelope. Reduced façade surface and micro-climate outdoor air temperatures allow lower heat conduction through the buildings envelope and for lower air infiltration into buildings, thus improving energy performance and reduces energy use.

In 2015 a research study was conducted called "A Comparative Study on Green Wall Systems (GWS)" where an analysis of four types of vertical planting systems (direct, indirect, GWS based on planter boxes and GWS based on felt layers) presented an overview of calculations based on building energy efficiency improvements in respect to the green façade technologies.

The benefits that can be estimated from the vertical planting systems are dependent on the growing rate of the plants covering the building envelope. For the direct and indirect system the full covering of the facade by H. helix is estimated after 20 years (according to Bellomo [Ref 7] 0.5 m/year of vertical growing). For both of the vertical planting systems the study calculated the beneficial value after installation with several material layers involved. For calculating the energy savings for heating, due to the increase of the insulating properties with vertical planting systems, the additional thermal resistance was assumed to be 0.09 K m2 W-1.

In the study, a three storey building with a ground floor area of 75m2 and with a volume of 296m3 (a total of 100m2 building's envelope) was observed in two different climate zones: temperate climate and the Mediterranean climate. A temperate climate zone was chosen to analyze the insulation properties of a green wall, and Mediterranean for the living wall's cooling potential.

The energy savings due to the cooling potential of the four vertical planting systems is based on the research conducted by Alexandri and Jones [Ref 8], regarding the temperature decrease in an urban canyon with green facades and the percentage of reduction that is reached for the air-conditioning.

Thanks to the insulating properties of vertical planting systems, the conducted calculation in the study was based on energy savings for heating in cooler, temperate climate zone, and for cooling in warmer, the Mediterranean climate zone.

As explained in the study:

"For the direct and indirect greening systems, the energy saving for heating is estimated as 1.2% of the annual consumption. For the green wall systems based on planter boxes and felt layers the saving was respectively 6.3% and 4%. The temperature decrease thanks to a green layer is estimated to be 4.5◦C (43% energy saving for air conditioning) for the Mediterranean climate and 2.6 for the temperate climate according to Alexandri and Jones."

In correlation to the above-mentioned study, other case studies have shown that the surface of an exterior green wall is up to 10°C cooler than an exposed wall, therefore considerably less heat is radiated inward, and less cool air is transmitted outward of a building. Not only exterior green walls have beneficial value to energy sufficiency in buildings, but also interior green walls help save energy consumption during the summer. Through the process known as transpiration* plants cool their surrounding environment slightly. With each additional plant this increases and therefore a green wall, with hundreds of plants, can reduce the temperature of a room by anywhere from 3 to 7°C. Some studies have shown that interior green walls can cut electricity bills by up to 20%.

Improved indoor air quality

Air pollutants are present not only in the atmosphere, but also inside buildings where different interior materials (adhesives, carpets, electronic equipment and cleaning fluids) emit volatile organic compounds (VOCs) and other toxic chemicals. These chemical compounds can negatively affect the habitant's wellbeing.

Plants are the most important part of a green wall construction. They are a key factor in creating a sustainable environment. By absorbing the chemical compounds found indoors, plants freshen the air, breathing in a new life into your home, office space and the overall habitat.

However, not all plants have the same cleansing properties. In 1989, NASA has conducted a thorough study called "Interior Landscape Plants for Indoor Air Pollution Abatement" [Ref 8]. This study classified the best air-filtering indoor plants that could be easily bought at a local flower shop. While the research does date back over 25 years ago, the findings have stood the test of time and are regarded as the most comprehensive and accurate results to date.

The study has classified 5 main particles that are in the air and have a negative effect on human health:

- **Trichloroethylene.** Causes dizziness, headache, nausea and vomiting, followed by drowsiness and coma.
- **Formaldehyde.** Causes nose, mouth and throat irritation, in severe cases can add swelling of the larynx (a.k.a. "voice box") and lungs.
- **Benzene.** Causes irritation to eyes, drowsiness, dizziness, increase in heart rate, headaches, confusion and in some cases a person can become unconscious.
- **Xylene.** Causes mouth and throat irritation, dizziness, headache, confusion, heart problems, liver and kidney damage and coma.
- **Ammonia.** Causes eye irritation, coughing and sore throat.

In the article of "Green over Gray" website it is stated that an average person spends over 90% of their time indoors which means that we breathe in the toxic chemicals (mentioned above) constantly. Air quality is an important aspect of health and wellness. Thus, spending a lot of time in a plant-less environment can lead to an increase in depression, sickness, reduction in workability and other illnesses.

But recent studies have shown that having vegetation inside increases productivity at workplaces and reduces the symptoms of discomfort indoors. According to scientific reports carried out at American and European Universities, simply having a view of plants in a working environment gives positive physiological responses. This translates into greater employee efficiency and decreases the number of days off, due to sickness which results in increased earnings for a company. Moreover, gardens that are incorporated into hospitals calm patients leading to the improvement in clinical outcomes and shortened stays.

Through smart and creative design, green walls can be installed not only as a means of air filtering system, but also as an interior design element. Although there are many aspects that need to be taken into consideration when choosing the correct green wall type and species of plants. There are thousands of plant species to choose from, but only a few have visible effects when implemented as an interior element. The table below shows the most effective plants to choose from for fighting indoor air pollutants. It is a known fact that people feel more relaxed and feel less stressed when surrounded by vegetation. Many articles write about that it is most likely due to man's evolutionary bond with plants. One of the explanations could be that, according to some optometrists, the human eye can differentiate between 2,000 shades of green, but only 100 shades of red. Through human evolution, recognizing a plant's shade of green was really important when either eating it or using it for shelter or medicine. This could be one of the reasons why we feel so comfortable around plants.

A study carried out at Washington State University [Ref 10] had participants' blood pressure and emotions monitored while completing a simple, timed computer task in the presence or absence of plants. It concluded that when plants were added to this interior space, the participants were more productive (12-percent quicker reaction times) and less stressed (lower blood pressure). In addition, immediately after completing the task, participants in the room with plants present reported feeling more attentive than people in the room with no plants. It has been proven that hospitals that incorporate gardens calm patients, improve their wellbeing and foster improvement in clinical outcomes, such as reducing pain medication intake and shortening their stays.

The quality of air is extremely important for our health and wellbeing. Plants have been proven to have filtering properties of airborne toxins and chemicals. They also add energy rich oxygen into the air we breathe. A green wall, with thousands of plants has a major positive impact when implemented in an indoor environment.

NOISE REDUCTION

Noise plays an important part in our everyday life. We are surrounded by it almost all the time of our everyday life. It is a non-removable part of our environment that can be both pleasing and agonizing. Annoying noises such as street sounds, loud people or obnoxious music can disrupt an individual's concentration and peace of mind. The reason for loud noises is due to the echo created by all the sound waves bouncing off the walls, ceilings, floors and other hard objects.

A new study conducted by an agricultural engineer ZaloaAzkorra , has proven that by correctly installing vertical planting systems they can provide passive acoustic insulation properties. The main principle of the study was to show two main plant responses when encountering sound vibrations. First, sound can be reflected and scattered (diffracted) by parts of a plant, such as trunks, branches, twigs and leaves. A second response is the absorption by vegetation. This effect can be attributed to mechanical vibrations of plant elements caused by sound waves, leading conversion of sound energy to heat.

To prove the beneficial value of green wall acoustic insulation properties, ZaloaAzkorra performed her experiment within a reverberation chamber* in two different laboratory settings with a modular green wall (see picture 20). These preparations were made accordingly to the international standards.

CONCLUSION

Our planet is facing a threat of urbanization and an unavoidable increase in population. With recent climate changes and the danger of global warming, new, more developed and environmentally friendly solutions must be implemented in our building industry to preserve our planet Earth.

In my opinion, one of the best environmentally friendly solutions would be the implementation of vertical planting systems or, in other words - green walls. The incomparable benefits that these vegetation full walls provide can prevent global threats such as climate changes, air pollution, green-house and urban heat island effects. Of all the design and technological options open to building designers, it is hard to argue that there are strategies that would have a greaterimpact – environmentally, socially and aesthetically – across both building and urban scales than the implementation of green walls in cities with larger numbers of population.

Even though green walls are an ancient concept, only recently the implementation of nature to the building's construction has been standardized for aesthetic use. Therefore, green walls are a relatively new environmentally friendly solution as the use of them started several decades ago. Of course, there are many more technologies that have direct beneficial value in solving certain global and urbanization problems. But the implementation of green walls have significant benefits simultaneously upon installation, both for the building (improving its appearance and energy efficiency) and the surrounding environment (reducing air pollution and urban heat island effect).

Green walls can not only prevent global warming by reducing the heat island effect and improving the building's energy efficiency, but can also have considerate beneficial value to an individual's health and wellbeing. By a single vegetated interior wall the indoor environment will have a natural air filtration system, reducing the amount of toxins in the air, as well as improving the habitants concentration levels, enhance his or hers workability and breathe in new and positive emotions into the room.

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Pollution in Ganga

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The Ganges River is one of the most polluted rivers in the world yet is used by 500 million people for domestic, industrial, and agricultural purposes. Without proper waste management procedures, the waste generated from inhabitants and local industries have been thrown directly into the river, resulting in heavily polluted waters. People are using this contaminated water out of necessity and it is causing many to experience gastrointestinal diseases that can lead to death if untreated. The pollution has caused less dissolved oxygen to be available for aquatic life, resulting in a decrease of some plant and animal species. Our research supports our hypothesis that the level of pollution in the Ganges has been relatively constant over time due to the lack of effective sewage treatment plants. The amount of pollution, measured by faecal coliform and biological oxygen demand (BOD) levels, are impacted by a number of factors dependent on the location at which the sample was collected. These factors include the flow of the river, the amount of aquatic life, the local population, and the number of nearby industries. These factors, along with our limited time and knowledge, prevent us from concluding that the river's overall levels of FC and BOD show any directional trend. However, we can conclude that the pollution levels have been constant in the sense that they are consistently measured above the levels permissible for human consumption. While the local government has implemented waste treatment facilities and water monitoring stations, these plans have been largely ineffective in improving the water quality to a level safe for inhabitant usage. Many of the treatment plants were not designed to treat the amount of waste generated in that area, leaving some plants unable to treat all of their waste while others are capable of treating more waste than they actually have. Some of the treatment plants are completely inoperable due to clogged or disconnected pipes unable to be repaired because of the lack of funding and skilled workers. The plants that are functioning experience frequent power outages that temporarily debilitate their ability to treat water. When plants are capable of treating the waste water, the clean water is often used for agricultural purposes instead of being placed into the river. While this benefit malnourished inhabitants by providing them with more crops, it decreases the flow of the river resulting in more concentrated amount of pollutants. Our research points to the need for adequate fundraising in order to make required changes in the current system. Once funding is acquired, resources should be focused on repairing sewage treatment plants that are already built. Emphasis should be put on ensuring the treatment load matches the demands of the area, with leeway for the inevitable growing population. Funding must be invested in purchasing generators that allow treatment plants to run during the frequent power outages. A task force of qualified scientists and engineers must work together to train more individuals on running and maintaining the current systems in order to keep treatment malfunctions to a minimum. This is a multivariable problem with no easy solution, however strategic action must be a priority for the Indian government in order to improve the lives of inhabitants and the river ecosystem.

Keywords: Eco-system, outrage, biological oxygen demand

INTRODUCTION

Pollution of the **Ganga**, the largest river in India, poses significant threats to human health and the larger environment. Severely polluted with human waste and industrial contaminants, the river provides water to about 40% of India's population across 11 states, serving an estimated population of 500 million people or more, more than any other river in the world.

Today, Ganges is considered to be the fifth most polluted river in the world. However, pollution has been an old and continuous process in the river as by the time people were finally speaking of the Ganges as polluted, stretches of over six hundred kilometers were essentially ecologically dead zones.A number of initiatives have been undertaken to clean the river but failed to deliver desired results. After getting elected, India's Prime minister Narendra Modi affirmed to work in cleaning the river and controlling pollution. Subsequently, the Namami Ganga project was announced by the government in the July 2014 budget. An estimated Rs 2,958 Crores have been spent till July 2016 in various efforts in cleaning up of the river.

Rapidly increasing population, rising standards of living and exponential growth of industrialization and urbanization have exposed water resources, in general, and rivers, in particular, to various forms of degradation. The mighty Ganga is no exception. The deterioration in the water quality impacts the people immediately. Ganga, in some stretches, particularly during lean seasons has become unfit even for bathing. The threat of global climate change, the effect of glacial melt on Ganga flow and

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the impacts of infrastructural projects in the upper reaches of the river, raise issues that need a comprehensive response.

In the Ganga basin approximately 12,000 million liters per day (mld) sewage is generated, for which presently there is a treatment capacity of only around 4,000 mld. Approximately 3000 mld of sewage is discharged into the main stem of the river Ganga from the Class I & II towns located along the banks, against which treatment capacity of about 1000 mld has been created till date. The contribution of industrial pollution, volume-wise, is about 20 per cent but due to its toxic and non- biodegradable nature, this has much greater significance. The industrial pockets in the catchments of Ramganga and Kali rivers and in Kanpur city are significant sources of industrial pollution. The major contributors are tanneries in Kanpur, distilleries, paper mills and sugar mills in the Kosi, Ramganga and Kali river catchments.

LITERATURE REVIEW

Just as it enters the plains at Haridwar. From there it flows as a trickle for a few hundred kilometers until Allahabad, from where it is recharged by its tributaries, it is filled with all pollutants from various sources. The Ganga receives over 60 per cent of its discharge from its tributaries. The contribution of most of the tributaries to the pollution load is small, except from the Gomti, The Ganga rises on the southern slopes of the Himalayan ranges (Figure I.2.1) from the Gangotri glacier at 4,000 m above mean sea level. It flows swiftly for 250 km in the mountains, descending steeply to an elevation of 288 m above mean sea level. In the Himalayan region the Bhagirathi is joined by the tributaries Alaknanda and Mandakini to form the Ganga. After entering the plains at Haridwar, it winds its way to the Bay of Bengal,covering 2,500 km through the provinces of Uttar Pradesh, Bihar and West Bengal (FigureI.2). In the plains it is joined by Ramganga, Yamuna, Sai, Gomti, Ghaghara, Sone, Gandak, Kosi and Damodar along with many other smaller rivers. The purity of the water depends on the velocity and the dilution capacity of the river. A large part of the flow of the Ganga is abstracted for irrigation Damador and Yamuna rivers, for which separate action programmes have already started under Phase II of "The National Rivers Conservation Plan". The Ganga river carries the highest silt load of any river in the world and the deposition of this material in the delta region results in the largest river delta in the world (400 km from north to south and 320 km from east to west). The rich mangrove forests of the Gangetic delta contain very rare and valuable species of plants and animals and are unparalleled among many forest ecosystems.

EXPLOITATION OF GANGA RIVER

In the recent past, due to rapid progress in communications and commerce, there has been a swift increase in the urban areas along the river Ganga, as a result the river is no longer only a source of water but is also a channel, receiving and transporting urban wastes away from the towns. Today, one third of the country's urban population lives in the towns of the Ganga basin. Out of the 2,300 towns in the country, 692 are located in this basin, and of these, 100 are located along the river bank itself. The belief the Ganga river is "holy" has not, however, prevented over-use, abuse and pollution of the river. All the towns along its length contribute to the pollution load. It has been assessed that more than 80 per cent of the total pollution load (in terms of organic pollution expressed as biochemical oxygen demand (BOD)) arises from domestic sources, i.e. from the settlements along the river course. Due to over-abstraction of water for irrigation in the upper regions of the river, the dry weather flow has been reduced to a trickle. Rampant deforestation in the last few decades, resulting in top soil erosion in the catchment area, has increased silt deposits which, in turn, raise the river bed and lead to devastating floods in the rainy season and stagnant flow in the dry season. Along the main river course there are 25 towns with a population of more than100,000 and about another 23 towns with populations above 50,000. In addition, there are 50 smaller towns with populations above 20,000. There are also about 100 identified major industries located directly on the river, of which 68 are considered as grossly polluting.

A pile of discarded clay idols on the river bank. Fifty-five of these industrial units have complied with the regulations and installed effluent treatment plants (ETPs) and legal proceedings are in progress for the remaining units. The natural assimilative capacity of the river is severely stressed. Source: Presentation to NAC members by NRCD in 2006The principal sources of pollution of the Ganga river can be characterized as follows:

- Industrial sewage is going into the river.
- Solid garbage thrown directly into the river.
- Non-point sources of pollution from agricultural run-off containing residues of harmful pesticides and fertilizers.
- Animal carcasses and half-burned and unburned human corpses thrown into the river.
- Defecation on the banks by the low-income people.

- Mass bathing and ritualistic practices. A dhobi ghat in operation.

Objective of Research

- Control of non-point pollution from agricultural runoff, human defecation, cattle wallowing and throwing of unburnt and half burnt bodies into the river.
- Research and Development to conserve the biotic, diversity of the river to augment its productivity.
- New technology of sewage treatment like Up-flow Anaerobic Sludge Blanket (UASB) and sewage treatment through afforestation has been successfully developed.
- Rehabilitation of soft-shelled turtles for pollution abatement of river have been demonstrated and found useful.
- Resource recovery options like production of methane for energy generation and use of aquaculture for revenue generation have been demonstrated.
- To act as trend setter for taking up similar action plans in other grossly polluted stretches in other rivers.

DATA ANALYSIS AND INTERPRETATION

GAP (Ganga Action Plan)

Inertia in taking action to reduce the level of pollution stemmed largely from a wide spread belief that the Ganga, as a holy river, had the ability to purify all that came into contact with it. Although there is some scientific evidence for the Ganga river's high capacity to assimilate (i.e. biodegrade) a large level of organic waste input, including pathogens, but no river can sustain its self-purifying power with this kind of over-use,misuse and abuse of its waters. The Ganga Action Plan (GAP) originated from the personal intervention and interest of our late Prime Minister Mrs. Indira Gandhi who had directed the Central Board for the Prevention and Control of Water Pollution, now Central Pollution Control Board (CPCB)to do a comprehensive survey of the situation in 1979. CPCB published two comprehensive reports which formed the base for GAP in Oct 1984 but was not presented to the nation formally due to assassination of Smt Indira Gandhi. In Feb 1985, the Central Ganga Authority (CGA) with the PM as Chairman was formed, with an initial budget of Rs 350 crore to administer the cleaning of the Ganga and to restore it to pristine condition by our late PM Sh Rajiv Gandhi. In June 1985, the Ganga Project Directorate (GPD) was established as a wing of the Department of Environment. GAP was launched on June 14, 1986 by Shri Rajiv Gandhi at Varanasi.

Scientific awareness

There are 14 major river basins in India with natural waters that are being used for human and developmental activities. These activities contribute significantly to thepollution loads of these river basins. Of these river basins the Ganga sustains the largestpopulation. The Central Pollution Control Board (CPCB), which is India's national bodyfor monitoring environmental pollution, undertook a comprehensive scientific survey in1981-82 in order to classify river waters according to their designated best uses. Thisreport was the first systematic document that formed the basis of the Ganga Action Plan(GAP). It detailed land-use patterns, domestic and industrial pollution loads, fertilizer andpesticide use, hydrological aspects and river classifications. This inventory of pollutionwas used by the Department of Environment in 1984 when formulating a policydocument. Realizing the need for urgent intervention the Central Ganga Authority (CGA)was set up in 1985 under the chairmanship of the Prime Minister. The Ganga Project Directorate (GPD) was established in June 1985 as a national bodyoperating within the National Ministry of Environment and Forest. The GPD wasintended to serve as the secretariat to the CGA and also as the Apex Nodal Agency for implementation. It was set up to co-ordinate the different ministries involved and toadminister funds for this 100 per cent centrally-sponsored plan. The programme wasperceived as a once-off investment providing demonstrable effects on river water quality.

The execution of the works and the subsequent operation and management (O&M) were the responsibility of the state governments, under the supervision of the GPD. The GPD was to remain in place until the GAP was completed. The plan was formally launched on14 June 1986. The main thrust was to intercept and divert the wastes from urbansettlements away from the river. Treatment and economical use of waste, as a means of assisting resource recovery, were made an integral part of the plan. It was realized that comprehensive coordinated research would have to be conducted on the following aspects of Ganga:

- The sources and nature of the pollution.
- A more rational plan for the use of the resources of the Ganga for agriculture, animalhusbandry, fisheries, forests, etc.
- The demographic, cultural and human settlements on the banks of the river.

- The possible revival of the inland water transport facilities of the Ganga, together with the tributaries and distributaries. The GAP was only the first step in river water quality management. Its mandate waslimited to quick and effective, but sustainable, interventions to contain the damage. The studies carried out by the CPCB in 1981-82 revealed that pollution of the Ganga was increasing but had not assumed serious proportions, except at certain main towns on the river such as industrial Kanpur and Calcutta on the Hoogly, together with a few other towns. This strategy was adopted forurgent implementation during the first phase of the planunder which only 25 town sidentified on the main river were to be included. The studies hadrevealed that:
- 75 per cent of the pollution load was from untreated municipal sewage.
- 88 per cent of the municipal sewage was from the 25 Class I towns on the main river.
- Only a few of these cities had sewage treatment facilities (these were very inadequateand were often not functional).
- All the industries accounted for only 25 per cent of the total pollution (in some areas,such as Calcutta and Kanpur, the industrial waste was very toxic and hard to treat).

Objective of GAP

The objectives of the GAP were broad: to abate pollution and improve water quality, to conserve biodiversity and develop an integrated river basin management approach, to conduct comprehensive research to further these objectives, and to gain experience for implementing similar river clean-up programs in other polluted rivers in India. A plan of action was developed in order to achieve these objectives, those actions that addressed the major, direct causes of pollution in the Ganga were identified as "core sector"schemes, and those that address indirect sources or sources deemed to be direct but of a lower impact were called "non-core sector". Core sector schemes included theinterception and diversion of domestic wastewater including the construction andrehabilitation of sewers and pump houses, while non-core sector schemes consisted of the installation of crematoria, river front development and aesthetic improvement, implementation of low cost sanitation systems, and miscellaneous activities such as water quality monitoring, research programmes, and identification and management of waste from grossly polluting industries. At the time of launching, the main objective of GAP was to improve the water quality of Ganga to acceptable standards by preventing the pollution load reaching the river. However, as decided in a meeting of the Monitoring Committee in June 1987 under the Chairmanship of Prof MG K Menon, then Member, Planning Commission, the objective of GAP was recast as restoring the river water quality to the 'Bathing Class' standard which is as follows:

PARAMETERS	PERMISSIBLE LIMIT
BOD	3mg/lmax.
DO	5mg/lmin.
TOTAL COLIFORM	MPN10000/100ML
FAECAL COLIFORM	MPN 2500/100ML

CLASS	DESIGNATED BEST USE (DBU)	CRITERIA
A	Drinking water source without conventional treatment but after disinfection	pH-6.5-8.5 Dissolved oxygen-6mg/l or more Biochemical oxygen demand-2mg/l or less Total coliform-50MPN/100ml
B	Outdoor bathing(organized)	pH-6.5-8.5 dissolved oxygen-5mg/l or less biochemical oxygen demand 3mg/l or less total coliform-500MPN/100ml
C	Drinking water source with conventional treatment followed by disinfection	pH-6.5-8.5 dissolved oxygen-4mg/l or more biochemical oxygen demand-3mg/l or less total coliform-5000MPN/ml
D	Propagation of wildlife and fisheries	pH-6.5-8.5 dissolved oxygen-4mg/l or more free ammonia -12mg/l
E	Irrigation, industrial cooling and controlled waste disposal	pH-6-8.5 mhos/cmμ electrical conductivity-2250 sodium absorption ratio-26 boron-2mg/L MPN most

The multi-pronged objectives were to improve the water quality, as an immediate short-termmeasure, by controlling municipal and industrial wastes. The long-term objectives were to improve the environmental conditions along the river by suitably reducing all the polluting influences at source. These included not only the creation of waste treatment facilities but also invoking remedial legislation to control such non-point sources as agricultural run-off containing residues of fertilizers and pesticides, which are harmful for the aquatic flora and fauna. Prior to the creation of the GAP, the responsibilities for pollution of the river were not clearly demarcated between the various government agencies. The pollutants reaching the Ganga from most point sources did not

mix well inthe river, due to the sluggish water currents, and as a result such pollution often lingeredalong the embankments where people bathed and took water for domestic use.

Major Findings

The GAP had a multi-pronged strategy to improve the river water quality. It was fully financed by the central Government, with the assets created by the central Government to be used and maintained by the state governments. The main thrust of the plan wastar geted to control all municipal and industrial wastes. All possible point and non-pointsources of pollution were identified. The control of point sources of urban municipal wastes for the 25 Class I towns on the main river was initiated from the 100 percentcentrally-invested project funds. The control of urban non-point sources was also tackled by direct interventions from project funds. The control of non-point source agricultural run-off was undertaken in a phased manner by the Ministry of Agriculture, principally by reducing use of fertilizer and pesticides. The control of point sources of industrial wastes was done by applying the polluter-pays-principle.Source: Presentation to NAC members by NRCD in 2006 A total of 261 sub-projects were sought for implementation in 25 Class I (population above 100,000) river front towns. This would eventually involve a financial outlay of Rs4,680 million (Indian Rupees), equivalent to about US$ 156 million. More than 95 per cent of the program has been completed and the remaining sub-projects are invarious stages of completion. The resultant improvement in the river water quality, although noticeable, is hotly debated in the media by certain non-governmentalorganizations (NGOs). The success of the program can be gauged by the fact that Phase II of the plan, covering some of the tributaries, has already been launched by the Government. Kanpur -a case study Ganga and GAP in Kanpur: Because of Kanpur's high level of pollution, Kanpur was identified as a key player in theGAP activities. Approximately Rs.730 million were invested under GAP Phase I in Kanpur. The total sewage generated in Kanpur at the time of launching of the GAP was around 285 MLD (Million Litres per Day) out of which 162 MLD of sewage was tapped under GAP Phase-I and diverted to sewage treatment plants. The objective of these plants was to treat this 162 MLD of domestic sewage and 9 MLD of tannery effluent generated from 175 tanneries and supply the treated wastewater to nearby villages to irrigate their farmlands. Four Intermediate pumping stations were built along the Ganga, and all wastewater drains, or nallas, were intercepted and diverted to the pumpingstations. The pumping stations were to release the wastewater into a common wastepipe leading to the main pumping station, which filters out solid waste and then pumps the remaining wastewater into three sewage treatment plants. Two of these plants (5MLD STP & 130 MLD STP) treat domestic wastewater, using sedimentation after aerobic treatment and anaerobic stabilization, and together have a capacity for 135MLD. Another treatment plant, with a capacity of 36 MLD incorporated Dutch technology known as Upflow Anaerobic Sludge Blanket (UASB). It makes use of anaerobic bacteria decompose the waste material, and requires some amount of post-treatment. This plant is meant for treating the tannery effluent, with the idea that the chromium and other heavy metals from this effluent should be recovered and recycled at the factory. Various other projects were undertaken as well, including cleaning the sewers, expansion of the sewer system, installation of electric crematoria, and the installation of low costsanitation systems.

Technology

One of the achievements of GAP is in terms of the development of appropriate technologies of sewage treatment as Upflow Anaerobic Sludge Blanket (UASB), improved oxidation ponds, sewage treatment through plantation, aquaculture using duckweeds and pisciculture etc. These technologies are cost effective in terms of operation &maintenance (O&M) and as such will reduce the burden on the State Governments onthis account. These developments will facilitate to make GAP and future programs sustainable. The per mild costs for capital and O&M and land requirement for different technologies used under GAP are given below: Statement showing per mild land requirement, capital costs and o & m expenditureunder different treatment technologies friendly and relevant for health.

Domestic waste

The major problem of pollution from domestic municipal sewage (1.34 × 10m3d-arising from the 25 selected towns was handled directly by financing the creation of facilities for interception, diversion and treatment of the wastewater, and also bypreventing the other city wastes from entering the river. Out of the 1.34 × 106m3d-1of sewage assessed to be generated, 0.873 × 106m3d-1was intercepted by laying 370 km of trunk sewers with 129 pumping stations as part of 88 sub-projects. The

laying of sewers and the renovation of old sewerage was restricted only to that required to trap the existing surface drains flowing into the river. Facilities for solid waste collection using mechanized equipment and sanitary landfill, low-cost toilet complexes (2,760complexes), partly-subsidized individual pour flush toilets (48,000), 28 electric crematoriums for human corpses, and 35 schemes of river front development for safer ritualistic bathing, were also included. A total of 261 such projects were carried out in the25 towns. The programmed also included 35 modern sewage treatment plants. The activities of the various sub-projects can be summarized as follows:

Industrial waste

For monitoring and control of pollution from industry, 68 grossly polluting industries located on the banks of Ganga and responsible for about 80% of the total industrial pollution were identified in 1985. These industries have been monitored rigorously. Atthe time of launching GAP, only 14 units were equipped with proper effluent treatment plants (ETPs). In June 1995, 55 units of these had set up the ETPs and 12 units had been closed down permanently with the remaining one unit having changed the technology and thereby not needing an ETP. Currently, ETPs in 45 units are operating satisfactorily and 23 units have been closed down. According to fresh surveys for grossly polluting industries, in addition to the 68 units already identified, another 119 units have been listed for monitoring purposes. Of these, 37 units are complying with the discharge standards, 9 units have been closed down and action has been initiated against the remaining 73 units under the Environmental Laws. The enforcement of the water (Prevention and Control of Pollution) Act and the Environment Protection Act against the defaulting industrial units is being done by the CPCB and the SPCBs. The NRCD plays a supervisory role over the SPCB with regard to the control of industrial pollution in theriver included under the NRCP.

LIMITATION

However, certain major limitations have surfaced which are as given below:

1. States particularly Bihar and UP are unable to provide timely and adequate funds for O&M of assets created under GAP.
2. In Bihar, O&M has been grossly inadequate. The State Government has neither been able to provide funds nor the required power on a continuous basis for O&M of assets like STPs, pumping stations, crematoria etc. Thus, the operation of nearly all the assets has practically come to a halt.
3. O&M of conveying sewers and intermediate pumping stations has been grossly neglected in UP. As a result, despite the facilities being available, raw sewage is still finding its way into the river at several places.
4. Erratic and poor availability of power for operating the pumping stations, STPs and crematoria is a major bottleneck in UP. Although, for such installations dedicated power supply had been provided for, this has not been adhered to by UPSEB. As a result, in the event of power failures, raw sewage finds its way into the river and the treatment plants are adversely affected.
5. O&M of facilities like toilets and bathing ghats has been neglected in general by the local bodies. Local bodies have also failed in discharging other civic functions in GAP towns.
6. The stretch of the river from Farrukhabad to Varanasi in general and Kanpur in particular is very critical in terms of the availability of the minimum flow in the river. At Kanpur, the pollution load from both the municipal as well as industrial sources is significantly large and the dilution capacity of the river is severely limited. As a result, the desired improvement in the river water quality has not been achieved at Kanpur.

7. It has been possible to minimize the organic pollution (which is indicated by BOD) reaching the river through the GAP. However, there has been only

RECOMMENDATION

Apart from the visible improvement in the water quality, the awareness generated by the project is an indicator of its success. It has resulted in the expansion of the programme over the entire Ganga basin to cover the other polluted tributaries. The GAP has further evolved to cover all the polluted stretches of the major national rivers, and including a few lakes. Considering the huge costs involved the central and state governments have agreed in principle to each share half of the costs of the projects under the "National Rivers Action Plan". The state governments are also required to organize funds for sustainable O&M in perpetuity. Initially, the plan was fully sponsored by the central Government.

Conclusions and lessons learnt

The GAP is a successful example of timely action due to environmental awareness at the governmental level. Even more than this, it exhibits the achievement potential which is attainable by "political will". It is a model which is constantly being upgraded and improved in other river pollution prevention projects. Nevertheless, some very important lessons have been learned which are being incorporated into further projects. These include lessons learned about poor resource recovery due to poor resource generation ,because of the lower organic content of Indian sewage. This may be due to less nutritious dietary habits, higher water consumption, fewer sewer connections, higher grit loads, insufficient flows and stagnation leading to bio-degradation of the volatile fractions in the pipes themselves. The assumed BOD design load of the plants were, in some cases, considered much higher than the actual BOD loading. This was due to a lack of practical experience within India and the fact that western experiences were not entirely appropriate .There were also many lessons learned associated with the project objectives, which overlapped in many areas with urban infrastructure development, especially when the GAP was mistakenly assumed to be a city improvement plan and are as summarized below:

- Systems designs have been optimized on the basis of actual surveys and investigations of wastewater generated from towns.
- Decentralized approach has been adopted for interception, diversion and treatment schemes to optimize the costs.
- Steps have been taken to ensure that land acquisition activities are completed in time.
- Adoptions of cost effective and appropriate technologies like UASB, Stabilisation ponds and Karnal technology wherever feasible to improve the sustainability of the program.

A VISION FOR GANGA

When we attempt to reconcile the significance of the sacred river in the past to its present reality, a most tragic paradox is encountered. Ganga today is being worshipped and defiled simultaneously. In fact, at most times, the process of worship itself has a polluting influence since bulk of the worship materials are disposed off in the river in ugly non-biodegradable polythene bags and in other unthinking ways. Even the mass bathing pollutes the river in a big way. The coexistence of worship and defilement of the Ganga defies logic and reason and leaves most observers confused. Polluting socio-religious practices apart, Ganga since perhaps about a century, has been subjected to a multiplicity of serious threats, multiplying in their impact and intensity every second. Unplanned urbanization and industrialization together with the population boom have extracted a very heavy price from the river. The painful reality still remains that environmental concerns in India continue to be the burden of a few green crusaders with the vast majority just plainly looking on. A serious erosion of faith has entered the psyche of the masses, gripping all with the thought that"nothing can be done". The rapid rise in the pollution of the river has been accompanied by (and also because of) mass apathy. Pollution and public concern of Ganga seem to exist in inverse ratios. If ever any crisis meant an opportunity to make a difference, it could not be truer than is the case for Ganga. The distressed river beckons all to come to its rescue. Admittedly, the task is Himalayan in nature and requires sustained convergence of comprehensive attempts by government, industries and civil society alike. It took hundreds of years of penance by Sage Bhagirath to bring the celestial river to earth and it would not be an exaggeration to say that today Ganga requires many Bhagirath's to survive and reclaim its sacred nature. Before any action can be initiated, all concerned should start thinking in terms of a new vision for Ganga. How do we want Ganga to be and what can be done to achieve that vision is the question posed to all of us? A new vision for a pristine and pure Ganga has to pour forth and translated on the ground. A new vision,

which needs churning of the spirit and mind. A new vision that can inspire the masses to action. A new vision that needs to reconcile the competing demands on the precious waters of the river with sustainability. It needs to think of the river as one organic entity where tinkering in one part affects the entire body of the river. A new vision which believes that if we as humans wish to survive, Ganga needs to survive. The eternal Ganga today, needs new heroes and new voices. A whole new approach is required to restore the river. The Ganga devotees who consider the river as a cleanser par excellence and treat Ganga as a deity who gives salvation need to be taught that Ganga has lost its divine role, Ganga has lost its cleansing properties and Ganga herself needs salvation. It's written in the scriptures that mere a glance or just chanting of Ganga gives salvation. So why can't we be satisfied with just chanting or glance? Do we need some super salvation that we need to wash our sins along with our bodily filth in the river? The Hindu religious leaders must play their role in educating the masses. Ironically governments have spent more money on Magh Melas, Ardha Kumbhs and Kumbhs than in cleaning the river. Millions of people congregate on the river banks, staythere for weeks and shit in the river bed. The entire shit ultimately goes to the river. Is it justified? These government sponsored and organized pollution events need rethinking. Why can't we be honest and warn people that Ganga waters are not worth bathing and drinking? Instead of admitting the facts and telling the truth, our top-level politicians go to such events, express their solidarity and deepen the superstition of the people by taking a dip in the river.

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