

ROLE OF SANCTIFIED GREEN AREAS (CPRS) IN MITIGATING ENVIRONMENTAL HAZARDS IN THE ERA OF GLOBALIZATION

By
Anju Bara Praba

INTRODUCTION

Unlike the sacred groves, a sanctified green area cannot be termed as wilderness but is a group of trees or it is a green landscape dotted with trees and plants in memory of some important events, personality or are worshipped as gods. This is the reason that in spite of such large scale modernization, drastic change in land use and lot of pressure most of such trees have not been felled. They have been standing amidst large-scale construction.

Today, due to various social, political and economic activities, capital city is under great pressure, which has made Delhi the fourth largest polluted city in the world. Delhi today is facing the problem of air pollution, (due to vehicles, industries and thermal power stations). Sewage garbage and industrial wastewater have been contaminating surface and ground water alike and rendering large extent of available land area into filth and waste. Thus these increasing problems need steps that can arrest further deterioration and set in operation this process of restoration of the affected area.

It is through the preservation of the sanctified green area and creation of a network of new ones that the extent of green area in Delhi can be increased. This is due course will enhance the number of tall trees. This is important because going in for plantation activity in additional areas is impossible in this city which itself is facing a problem regarding more space. Infact Delhi do not have sacred grove like the other states of India i.e Rajasthan, Haryana, Kereala etc, but yes there are quite a few green patched in and around and within religious places, memorial ground etc. Even at many sites the mere presence of sacred tree prevents it being felled. This established tradition if could be focused and the implied values widely spread, the community support be mastered for protection of surviving plants. Thus age old sentiments buttressed by scientific facts such as of the ability of trees, to abate pollution or transform sewage affected land and water need to be aroused to keep the economic and social greed's at bay.

In India trees have been regarded as an indispensable part of our life and their importance have been highlighted in the Scriptures and the Epics. Indian Culture and tradition has been influenced by the reverence for the nature's endowment. Trees have been associated with divine powers, deities, and various Nakshatras or the planets.

Green Area and pollution:

It is seen that on account of a host of natural and induced hazards almost all the metropolitan cities are now facing the serious problems of health and there has been a fall in the quality of life. Thus the green areas are no more considered only for scenic beauty or for aesthetic values but are needed for countering the multiple pollution hazards. This because the plants are the primary producers and better users of naturally available energy of the sun rays. Thus they themselves can set the process of bio degradation as well as are perhaps the best facilitators of all other biodegrading agents.

- Green belts act as a barrier for hot dust laden wind and also act as natural absorber or mitigator of such winds. These thus prevent further desertification of the area and keep the temperature quite low.
- In Delhi the major concern is to reduce the air pollution and for this some identified species have been planted recently which could lessen / absorb the particles that are

responsible for such toxicity in the air. A study has proved that vegetation at 200 m distance was able to reduce concentration of air pollutants by 120 gm/m³ (chandra, 1982 quoted from Om Kumar, et al. 1996)

- Dust along with the hot winds from the Thar dessert blow through the gaps in the outer Aravalli ranges and thus during the summers a desert like situation prevails in Delhi. A study conducted in the National Botanical garden, Calcutta reveals that the foliage has got the capacity to absorb dust. More research is going on to find out effective plant species and systems of plantations of such trees that can not only absorb these dust particles but also convert them into substance which could further be absorbed by the plant or excreted in the soil as non toxic materials.
- Studies have also shown that trees have the capacity to tolerate gases and particulates.
- Trees with their complex canopy and stand are one of the most effective deterrent to wind with high velocity and even cyclonic wind. These often break down the fury of winds and moderate the resultant damage.
- A combination of tall trees and shrubs when planted in strips 9-13 m wide was effective in controlling highway noises (Nancy Beckham, 1992). Hence Delhi Govt has been trying to introduce such species that can help in providing relief to the residents of those areas, which are affected by noise pollution.

Other aspects for considerations

The importance of trees has already been dealt and this information helps us to make an assessment of the need for such species in the city. Hence seeing the problem and the state, following needs to be taken care of.

Pollution Abatement

Seeing the extent of pollution in Delhi, it now became necessary that the steps be taken to reduce pollution. Research has proved that the suitable species if planted help in reducing the hazards of pollution. For pollution control, the species planted should have broad leaves, rough surface, ability to shed leaves, and presence of hairs. The species so selected have comparatively high rate of evapo transpiration and specific ability to promote the organic processes of bio -degradation.

Thus it is necessary that the concerned department start working in this direction keeping in mind the problems of Delhi. There is a that gives the list of the plants that needs to be planted for pollution abatement. A lot of effort has been done on behalf of the Forest Department and MCD of Delhi and other agencies of Delhi. But all these approaches of these agencies need to be streamlined and more focussed towards the need. The areal enlargement of areas under green cover to neutralise the induced pollution hazards as would become ideal cannot be achieved in Delhi. Thus alternatives in terms of more effective species to abate specific pollution i.e. to its air, water and land must receive attention. Similarly alternate composition and densities should be found through on site studies which could be sponsored through Universities, selected NGO's etc.

Participatory Forest Management in NCT Delhi

The green area is basically needed for the general welfare of the masses residing in Delhi. In Delhi the need for direct economic benefit is not felt. But services in terms of providing dust free environment, pure water, and air, shade, buffer zone against all types of pollution have caught the perception of various agencies and communities and other groups. The basic approach is for environmental equilibrium and pollution abatement.

A study on the forest plantation in the NCT of Delhi (AFC, 1996) have revealed that these are in areas facing environmental hazards of three kinds namely:

1. Areas facing pollution – air, water and land besides noise.
2. Degraded or waste lands through erosion, gully formation, quarrying etc and
3. Areas affected by flood along river Yamuna.

Management options for the three categories and for each of 12 sites were detailed in the published results of experiments and field experience else where (AFC, 1996).

While in respect of participatory forest management (PFM), it was realised that services and goods expected from plantations in NCT area will be different from other states. Some of these were listed as under (AFC,1996)

- a. Improvement in micro-level hydrologic regime
- b. Abatement of pollution of air, water and land
- c. Providing shade and protection against sun and dust.
- d. Developing shelter/ habitat in pockets over extensive area for small and beneficial life form like bird's etc.
- e. Goods such as organic matter through bio-degradation of wastes (organic) which would improve fertility of areas under greener y and also generate revenue for sale.
- f. Reduce hazards of noise

Type of area range from Government lands under the control of various departments, corporate and civic bodies as well as private individual. The participatory management would be variable and was conceived as in Table 3.7.2

Table 3.7.2 Conceptual model of Participatory Forest and other Green area management in NCT Delhi.

S.No	Type and location of areas of Greenery	Type of Participatory Management
1	Ridge areas and river fronts – Reserved Forest	By Deptt of Forest (DOF)
2	Other Protected and recreational areas with forest	JFM – DOF and Communities within and on fringe areas
3	Areas in and around commercial and industrial units	To be managed by the Industrial Authority, Corporate Bodies or Private Parties with technical guidance from DOF.
4	Areas along road side and banks of drains (public and semi public facilities)	To be managed jointly DOF and the counterpart Department / Agency concerned.
5	Areas in around health and educational centres, residential complexes	The greenery to be treated as equivalent community forest and should be under co-operative management of the communities with the help of DOF.
6.	Areas within the stretches which will continue to be under cultivation during transition period of 20 years and finally thereafter	Private or Communities to manage jointly with DOF.

Thus an organisational innovation s was suggested in the forum of Cadre of Green Guards (CGG) similar to the honorary traffic monitors. The cadre personnel will have to be registered with DOF and will be provided with technical and material back up for up- keep and care of these sites in liaison with the owners. These persons could be raised able bodied,

retired persons, students and other volunteers. They could have some token monetary grant to cover commutation charges and small incidentals. More attractive proposition should be to cover them under appropriate Medicare Scheme from the fund for care and improvement of these sites and also leave travel concession once in a year. These should motivate them to do justice to the task while the arrangement will save a fortune on departmental persons if deployed for such works.

Today everyone is aware of the negative externalities that have resulted of different types of pollution in Delhi. People have now become more conscious and some of them do try to protect / preserve the greenery surrounding them. Even the planners and the policy makers have realised that the importance of a stable eco-system of Delhi. Especially forest must remain rich, healthy in terms of appropriate species combination density to set in operation the natural processes of biodegradation, assimilation, re-circulation of pollutants in environmentally safe forms.

Therefore it must now be the agenda of the various departments to make some sort of voluntary committees or groups that can come up for the cause of saving the green areas and further increase it by plantation in small patches. Some institutions and research institute must also be included for such work. The programme should be of the people and to be supported appropriately by the Govt of Department and Corporate / Civic Bodies.

Waste Management

Delhi had a population of 7.7 million in 1998. This population generated about 1480 MLD of sewage of which only 745 MLD was collected and further treated. Thus within the metropolis and in other parts a considerable amount of waste is discharged either into river or on landfills. These needs to be treated so that water and nutrients locked in can be of some use for greening of the areas. Efforts are however being made by the MCD and PWD in their respective jurisdiction to raise plantation using sewage water. A technique has also been developed to use nutrient part of the waste as inputs for the growing plants. Similar to sewage, garbage from settlement poses a serious problem in terms of demanding fresh areas as landfills, causing contamination to surface and ground water. A survey carried out in 1996 revealed the gravity of this problem

Table: Garbage Hazards of Delhi

S.No	Details			
1.	Amount of garbage produced per day	7880 tonnes		
2.	No of Communities Collection Centres	1804		
3.	No of communities where garbage bins are absent -Middle income level colonies - Jhuggi clusters	508 1020		
4.	No of dumps not cleared for the last five years			
5.	Break-up of Garbage producing sectors is as under			
		Tonnes / day	Biodegradable	Recyclable
i.	Residential areas	3200	60%	35%
ii.	Bazaars/ Markets	2040	50 %	27%
iii.	Industrial Areas	1080	10%	80%
iv.	Railways stations	640	50%	48%
v.	Hospitals	550	-	6%

vi.	Rest	370	-	=
	Total	7880		

In Delhi economic consideration of perennial vegetation may not be that important as its multiple and complex influence to neutralize the degradation of the land, water, air and also the amount of sewage being produced is considered more important. Thus regeneration or re-establishment of green belts have now become imperative.

It would be necessary to limit the extent of area to be used as land fill. A greater part should be reusable. Nearly 30 % of the garbage are organic ones, is most suited to prepare organic manure through bio-degradation. The generated manure can be excavated after 4-6 months and sold for application to vast extent of alleviated lands which are starved of organic manure. The patches of landfill areas should be demarcated on different parts of the NCT and screened by two to three rows of appropriate tree species. This could be done on partnerships basis between DOF and MCD (**Note:-** Few solid waste management units have been set up by the Delhi Government recently.) So far some years land-fills will be necessary these solid wastes as well.

Findings

The site selected for the study were mainly 34.5 % were temples, 12.5 % churches, 12.5 % gurudwaras, 6.2 % mosque, 0.32 % Buddhist temples, 0.32 % Parsi temple, 9.4 % Jain Temples, 15.6 % Historical places & 0.32 % Bahai temple. All the above had their respective management committees to look after the whole campus. All the sites were inside the NCT of Delhi area.

Plant species found in the sampled sites

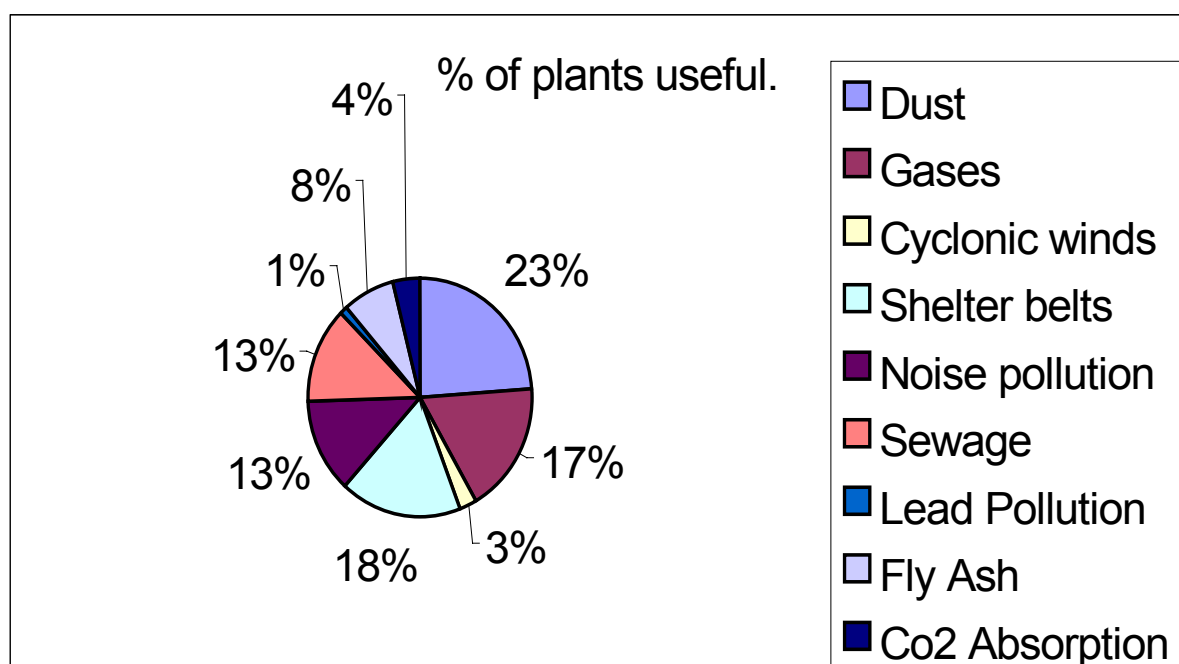
There were in all 70 species (as annexure). And quite a few of them were exotic and had been introduced in the distant past to even recent years. These planting work were done by various varied communities which came and conquered the NCT region for trade and commerce or for spiritual and cultural changes.

Plant composition:

This varied to a minimum of 6.7 % (2) to a maximum of 46.7 % (14) species.

The plant species found in the sampled sites differ in the kind of species widely. Many of the species found in the sampled sites have the natural capability to abate pollution which were very much prevalent in Delhi's atmosphere.

Figure :Different Uses of plants



There is a need to plant those trees that will help in reducing both noise pollution and pollution due to the vehicular traffic. Now a days the ground water is also getting polluted and hence work in is direction is urgently needed. There are 32 plant species which have been reported to be effective to various pollution effects Three species namely Peepal, Neem and bargad can tackle six different types of pollution while Jamun, Arjun and Imli can neutralise adverse ill-effects of five pollution types .Besides eight species which could retard two different pollution type and seven including the mango and Bel can handle two types of pollution. The choice of plant species could thus be made in urban afforestation to suit different city sector to the specific pollution hazards prevailing.

List of plants found in sanctified green areas of Delhi and suitable abatement of different types of pollution

Name of the trees	Du st	Gases/ particu late	Cyclo nic winds	Shelt er belts	Noi se	Waste water/gar bage	Lead polluti on	Flya sh	CO2 absorpt ion	Tot al no.
Neem	*	*		*	*	*		*		6
Eucalypt us		*		*		*				3
Asoka	*				*					2
Shahtute	*									1
Peepal	*	*	*		*			*	*	6
Ber		*				*				2
Janum	*			*	*	*	*			5
Mango	*			*						2
Kikar				*		*		*		3
Imli	*	*	*	*	*					5
Gulmoha r	*			*		*				3

Amaltas	*	*		*				*		4
Bargad	*	*		*	*					4
Pakar	*									1
Bel		*								1
Bamboo					*	*				3
Lagestro mia		*		*		*				3
Papri						*				1
Arjun	*	*		*	*	*		*		6
Seemal	*									1
Kadam	*			*						2
Jacarond a				*	*	*				3
Peltoforu m						*				1
Alstromi a						*				1
Bakain		*								1
Jackfruit		*								1
Casuarin a		*		*						2
Jungle Jalebi	*	*			*			*	*	4
Gular	*				*				*	3
Pilkhan	*				*					3
Amla	*	*				*				3
Shisham	*	*								2
Guava	*									1
Khajur	*									1
Sita ashok	*	*		*						3
Chilbil				*						1
Harsinge r	*	*								2
Anar	*									1
Bougain villae	*	*								2
Total	19	19	2	16	12	14	1	6	3	

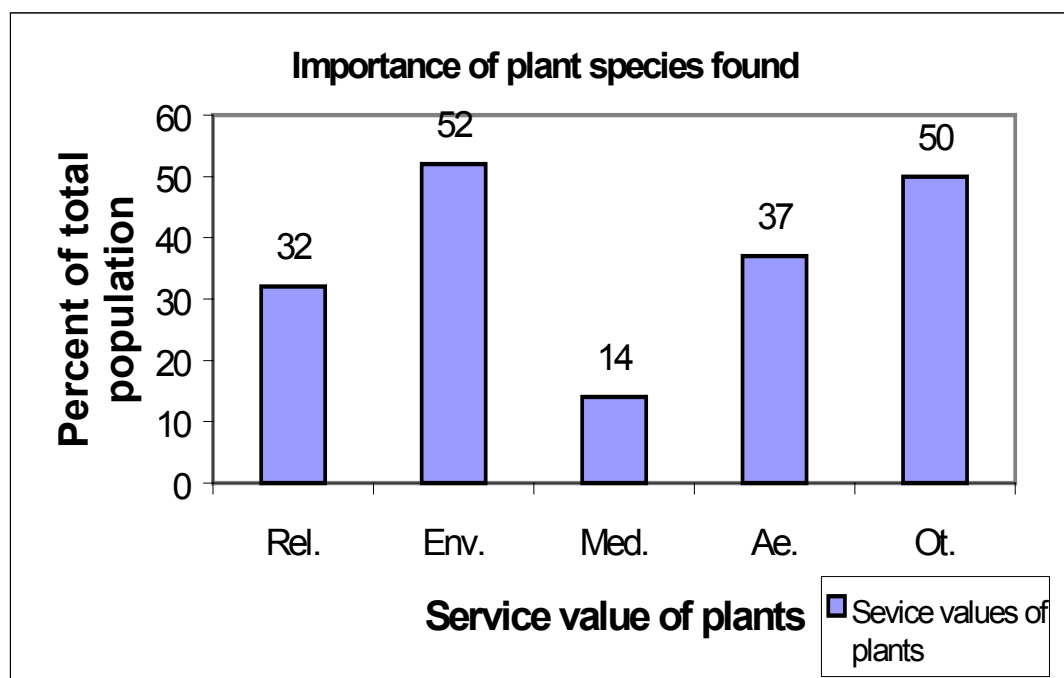
Various Service Value of Plants

The programme of afforestation and greenery in the NCT of Delhi gave preference to those plants which have (1) Ornamental appearance of the tree (2) Capability to provide shade and (3) Flowering nature. More of aesthetic looks to the city rather than the efficacy of these plant species in mitigating the effect of pollutants dominated in selection of plants. Perhaps, the pollution hazards had not become serious by then.

But in view of the serious pollution hazards it has been necessary to assess the ability of the standing species especially, which are of known environmental use. In all probability the results would reveal that there is an urgent need for increasing the number of such species

.The exercise to group the plants into five functional categories could lead to proper planning, management and protective measures. Trees, which are being revered, should be planted in such a way that other plant species are planted around it. In this way, protection of all the plants naturally takes place.

Importance of plant species



(Source:- Field data)

Rel... : Religious, Env... : Environmental, Med... : Medicinal, Ae... : Aesthetic, Ot... : Others

(Others include ; fruit bearing, shade, for cottage industry)

Area and Plant Population and Density found in the sites visited.

Table : Population and population Density of the trees

Ar ea	Sampled Area taken (in ha)	No.of Plants (Approx)	Plant Density
1.	3	22	7.33
2.	9	44	4.88
3.	10	52	5.20
4.	120	175	1.45
5.	1.5	98	65.33
6.	1.5	5	3.33
7.	15	160	10.66
8.	25	551	22.04
9.	117.5	10,000	85.106
10.	30	892	29.73
11.	2	61	30.5
12.	3.5	59	16.85
13.	0.5	45	90
14.	0.5	29	58
15.	2	26	13

16.	1.5	14	9.33
17.	3.5	20	5.714
18.	26.5	328	12.3
19.	7.5	45	6
20.	1	30	30
21.	4	5	1.25
22.	0.5	3	6
23.	2	37	18.50
24.	0.5	2	4
25.	1.5	16	10.6
26.	1	144	144
27.	2.5	23	9.2
28.	8.9	150	16.85
29.	3	130	43.3
30.	4.59	199	43.35
31.	1.25	292	233.6
32	**	**_	**
TOTAL		410.74	103696

** Plants not counted

It was found that the least of 1 plants per hectare to maximum of 233 plants were found. This result reflects that with a good managing committee many plants can be planted as well as saved respectively

Sustainability and Restoration of Delhi's Green Areas

In natural eco-system a balance has to be maintained through functioning of several of life forms and the process of production, degradation and regeneration of various attributes of the system. Land surface and soil profile act as the workhouse for the various communities supported by the eco-system. Since the primary and renewable source of energy are the sun rays and only plants can use this energy to produce food for all animals in all the levels. Thus productivity / Respiration (P/R) or O_2/CO_2 balance act as an indicator for such balance needs so as to prevent further degradation. As per the norms in a watershed if P/ R is greater or equal than 1 then the eco -system is said to stable and if the ratio is less than 1, then the system is highly heterotrophic which if not taken care of will lead to further degradation..

Ecologically this ratio is very necessary so as to come to rationale, which helps us to decide on the portion of the land that should be under green cover and also for other cultivation purposes. This proportion helps in perpetuating a system that could help automatic hydrologic replenishment through rainfall absorption, disposition amongst the soil moisture storage and outflows, also helps in rejuvenating the degraded areas, and re-enrichment of the areas.

A proposed norm has been considered for the various areas, which are as follows.

Table : Norms to assess the land for its improvement

Type of land	Indicators	Norms to assess improvement
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	Total area under green cover	Suggested % of land area
Plain Land	EF+EGA	10% of the total area
Rolling and undulating terrain	EF+EGA	20 % of the total land
Foot hills and sub-mountainous	EF+EGA	35% of the total area
Higher elevation and slopes	EF+EGA	50 % of the total area

EF- Existing Forest Area

EGA-Equivalent Green Area

Hence if seen in case of Delhi a large chunk stills need to be rejuvenated and the following gives the details. It should also be kept in mind that the terrain is not an ideal rolling or undulating one, and the area here is getting degraded due to the rapid modernization and mechanization. The pollution level is shooting the limit levels and hence ideally speaking it is assumed to be 20% of the whole area to green so as to abate the hazards of pollution.

Total area of Delhi	-	1486.89 Sq.Km or 148689 hectares
Total Sampled area	-	164.496 hectares
∴ % of sampled area	-	11 %

Thus only 11% of land mass has got 1,03696 number of plants on it. Ideally 20 % of 1486.39 is needed which is 29727.8 hectares.

∴ Left area to be planted - 29563.30 hectares (This includes wastelands.)

Benefits to be accrued with the help of the plants.

Table: Computed benefits per annum for old trees at the sampled sites

S.No	Benefits	Benefits per tree (Rs lakhs)/ per hectare(medium size)
1.	Production of O ₂	0.05
2.	Absorption of CO ₂	45
3.	Control of soil erosion	0.05
4.	Recycling of water	0.06
5.	Sheltering of birds, insects	0.05
6.	Control of air pollution	0.154
7.	Conversion to animal protein	0.004

(Source :-Sacred Groves of Kurekshetra, Haryana; RC 37)

The lowest estimate indicates that one tree will absorb minimum 1 tonne of CO₂ and release 0.67 tonne of O₂ (Source: Sacred groves of Rajasthan, RC-49). Thus if we try to estimate the amount of CO₂ absorbed and O₂ released, we arrive at the following.

The total tree found in 11% of the land mass	= 1,03696
Amount of CO₂ absorbed by1 tree	= 1 tonne

Hence amount of CO₂ absorbed by 103696 trees	= 103696 tonnes of CO₂
Amount of O₂ released by 1 tree	= .67 tonnes of O₂
Hence amount of O₂ released by 103696 trees	= 69476.32 tonnes of O₂

But by Odum's Law for equilibrium in the eco-system, O₂/CO₂ ratio should be equal to one or more than one. The present condition of the sampled sites in Delhi reveals that O₂/CO₂ ratio is (69476.32/103696) = 0.67. The value holds good for the sanctified green areas of Delhi only and it reveals that the conditions are highly heterotrophic which needs to be taken care of urgently. Delhi needs more green cover to combat with the existing pollution. To make the eco-system stable the ratio should be atleast 2 so that it is able to compensate those areas which has no green cover on it or areas where planting cannot be done due other commercial activities.

For this intense planting is to be done in areas available in such way that the ratio is more than 2 and there is scope for eco-development.

Recommendations

(a) Management & Co-ordination with other Agencies

There is no denying the fact that conservation & restoration processes of natural resources like forests is absolutely essential to contribute towards environmental sustainability and stability in eco-systems. Therefore, the role of so called traditionally managed holy areas act as complementary actors, in achieving such a target of increasing green area. For this is necessary that :

Such areas be denoted and the authority concerned should be made to look after the overall development of the place ; The technical know-how can be provided by the Forest Department or by the Horticulture Department. But as far as the protection is concerned, people nearby the localities should be encouraged for this work ;

A separate Committee especially constituting of the elders should be made ; For the religious institutions, besides religious sermons, people should be made aware of the need for plants & its protection ; and ,

NGOs and social workers should be involved for this purpose, as it will become easier to get the public co-operation. Forest Department can form promotional committees with the help of people. This necessary because only the Forest Department cannot do this task. Hence sites should be divided among the members with forest officials heading it. This will facilitate in both technical and financial help. In turn incentives could be provided to the members.

(b) Establishment of New Sanctified Areas

Those areas which have got religious importance but have got very few or no trees in their campus should be targeted. Initially with the help of the priests, mullahs, tree should be planted and it should be made the duty of these institutions to look after such areas. The followers or worshippers should also be involved as it is through them this concept can be spread in their own private houses or residence colony. New sanctified areas can be explored. First a religiously important plant should be planted and then a few other environmentally important *spp* can be planted. This work demands locating sites and also motivating personalities & for events for establishing new sites. These sites should be chosen to commensurate novel events such as those related to freedom struggle or the sites which are associated with seats of enlightenment or social reformation.

(c) Involvement of Schools/Institutions and Colleges and Observation of Tree Planting Day

Such a programme will help people to know the real reason and the importance of trees with respect to the NCT of Delhi. Information on natural conservation, and its direct relevance to better health should be emphasised and seminars should be held. Schools be involved in planting trees in various areas of Delhi. Students should also be encouraged to do the same in their respective houses.

Innovative ideas like planting in the wasteland should be done by these institutions as this forms a large patch of land. Initially on experimental basis, species specific to such areas must be planted. Initially, the areas should be given for experimental basis so that test could be carried-out.

Every sanctified areas of Delhi has the potential of planting at least 1-10 trees in their premises. Therefore, it is necessary that a Committee comprising of all the religious trusts be made and then they be encouraged to such work. The saplings can be provided free of cost from the Government nursery.

(f) More than 95 % of these areas had trust or Management Committee of their own. The main source of fund was from daily offerings. Individual offerings, schools, hospitals and Dharamshala and libraries. All these amount to a appreciable amount off money. But it was found these a very small fraction of the whole amount was used in planting trees, its protection and further increasing the green coverage of the surrounding areas. Thus it is necessary that more % of funds should be properly be utilised for tree planting scheme *i.e*, proper channelizing of fund.

(g) The plant species that are to be selected for planting should fulfil the given criteria

- fast growing
- perennial in nature
- evergreen
- large leaved
- rough bark
- indigenous
- ecologically compatible
- low water requirement
- needs minimum care
- is useful in pollution abatement.

d) Proper networking of the scattered sites.

Green sites can be found scattered all over Delhi and hence there is a need to plan a strategy for the development of the sites. It is important that every site has a member incharge of co-ordination with the committees, He will act as an anchorperson for all works. This helps in planning and executing the task and also helps in increasing the efficiency of the work. A common device for protective measure for these areas can be developed in this way.

e) Provision for Waste management.

There is a need for waste management hence special system / policies should be designed which proves to be useful for both the masses and flora growing in Delhi. For this specific groups needs to be constituted as it involves a lot of research and scientific base to work for the management of wastes.

f) It is a common site now to find areas around the trees being cementing so as to beautify or to give a clean picture of that place. But it is necessary that the root system is able to breathe and enough surface be left so that the water and air can reach the root zone which is important for the development of the root and hence for the whole plant

Conclusions

Today, Delhi is facing the problem of being the 4th largest polluted city in the World. Besides decentralization of the various offices, remedy lies in the proper management and planning of the land use of Delhi.

No doubt the sanctified areas form not more than 1 % of the total area, but if taken care, in planting those species that are needed to ameliorate the pollution, the problem can be reduced or the situation can be at least in hand.

The Delhi Government together with various other agencies have come-up with good plans for greening Delhi and to compare with what these small sanctified areas are doing is not possible as trusts/religious places do not keep aside funds, technical know-how especially for the plants. These have been followed since ages and till now people follow it. No one is there to challenge such old beliefs and traditions. But all this needs participation of the people. It is necessary that people are made aware of the need and they themselves come forward for planting, protecting and for proper management. The small and heterogeneous sanctified areas are ideally suited for this area and making of target group for the greening programme as a community or group action should be encouraged.

There are perhaps no sacred groves in NCT of Delhi in the manner these exist in many parts of the country. But there are large number of sanctified sites of types like Religious, historical and parks, gardens and nurseries.

In this NCT, notwithstanding tremendous post independence pressure of population, urbanization and industrialization, trees and plants survived in good strength on 250 sites out of 300 listed. The plant species found in reasonably good composition and diversity at good many sites.

Together these micro sites compared well with reduced ridge forest area in 92=92 . In 98-99 with substantial afforestation works, Area Eco Index (AEI)- Total Green Area as a percent of geographical area , rose to 13.1 percent. Sanctified Green Area (SGA) constituted to 16.82 % of this AEI. This is a significant contribution. Delhi should have an AEI of 20 % and to attain this immediately some improvement in SGA s would help significantly.

Similarly out of 70 plant species 56 % (39) have the pollution abatement abilities, which are most required in NCT. Eight of these among themselves can tackle multiple pollution problems. The highest six types of pollution are handled by *Neem*, *Peepal* and *Arjun*.

At the sites standing vegetation has been assessed to be absorbing 73, 851 tones of CO₂ annually and releasing O₂, which could fully be used by 12, 645 persons.

As green activities are being carried out by multiple agencies at grassroots level actors are of varied combination. This individual and grouped participation mode will be the key. Here

however, eco services specially abatement of pollution will be the chief benefit to draw various groups as partners.

Thus entire approach towards creation, maintenance and management has to be broad based and collaborative where scientific inputs are to be provided by the nodal department here Department of Forest and wildlife, NCT of Delhi. In order to make the residents and owners of land/ institutions etc actual actors there is a need to build an officials cadre of green Guards. Plant documents and reports should provide more of scientific channel collaborative efforts.

At the same time effective coordination, integrated planning and continuous monitoring and evaluation through external agencies are useful beside in-house efforts.

Recommendation

Realizing the importance of the sanctified area attempts should be made to create few more emphasizing on secular and scientific values of trees and plants specially to abate pollution and to help re circulate locked in water and nutrients in sewage, garbage and industrial effluents. Here is a need for the formation of cadre for this and proper orientation of people of this cadre.

Annexure: 1 Common Species found in the Sanctified Area

Sl.No	Species	Scientific Name	Sl.No	Species	Scientific Name
1.	Neem	<i>Azadirachta indica</i>	32.	Bamboo	<i>Dendrocalmus spp</i>
2.	Chir	<i>Pinus roxburghii</i>	34.	Duranta	<i>Duranta plumeri</i>
3.	Rubber	<i>Haevea bragelenesis</i>	35.	Satparni	
4.	Eucalyptus	<i>Eucalyptus spp</i>	36.	Lagestromia	<i>Lagestromia speciosa</i>
5.	Champa	<i>Ptero-spermum acerifolium</i>	37.	Philkhan	<i>Ficus infectoria</i>
6.	Asoka	<i>Polyanthia longifolia</i>	38.	Papari	<i>Pongamia pinnata</i>
7.	Shatute	<i>Morus alba</i>	39.	China Palm	<i>Phoenix spp</i>
8.	Peepal	<i>Ficus religiosa</i>	40.	Arjun	<i>Terminalia arjuna</i>
9.	Ber	<i>Zizyphus spp</i>	41.	Hybiscus	<i>Rosa sinensis</i>
10.	Jamun	<i>Syzium cuminii</i>	42.	Semal	<i>Bombax ceiba</i>
11.	Mango	<i>Mangifera indica</i>	43.	Mulbery	<i>Morus alba</i>
12.	Guava	<i>Psidium guajava</i>	44.	Harsingar	

13.	Lemon	<i>Citrus spp</i>	45.	Anar	<i>Punica grantum</i>
15.	Bottle Palm	<i>Phoenix spp</i>	46.	Kadam	<i>Anthocephalus cadamba</i>
16.	Ronjh	<i>Acacia leucophela</i>	47.	Jakaranda	<i>Jakaranda mimosofolia</i>
17.	Morphauki	<i>Thuja compacta</i>	48.	China Orange	<i>Citrus spp</i>
18.	Sita Ashok	<i>Saraca indica</i>	49.	Peltoforum	<i>Peltoforum ferruginium</i>
19.	Gular	<i>Ficus glomerata</i>	50.	Alestromia	<i>Alestomis scholaris</i>
20.	Drumstick	<i>Moringa oleifera</i>	51.	Bakain	<i>Melia azadirach</i>
21.	Kikar	<i>Acacia nilotica</i>	52.	Locart	<i>Eriobotrya japonica</i>
	Jack fruit	<i>Autocarpus heterphyllus</i>	53.	Chau	<i>Casuarina equistefolia</i>
22.	Chilbil		54.	Jangal jalebi	<i>Pitheolobium dulce</i>
23.	Tamarind	<i>Tamarindus indicus</i>	31.	Khirni	
24.	Gulmohar	<i>Delonix regia</i>	56.	Mohansiri	<i>Acacia auriculiformis</i>
25.	Amaltas	<i>Cassia fistula</i>	57.	Chakundi	<i>Cassia siamea</i>
26.	Bar	<i>Ficus bengalensis</i>	58.	Bougainvillea	<i>Bahhinia variegata</i>
27.	Custard Apple	<i>Anona squamosa</i>	59.	Khair	<i>A. catechu</i>
28.	Amla	<i>Emblica officinalis</i>	60.	Banana	<i>Musa paradisiaca</i>
30	Bel	<i>Aegle marmelos</i>	62	Bottle brush	<i>Callisylemon viminalis</i>

Annexure 2 : Species Diversity for the Sampled Sanctified Green sites of NCT of Delhi

Sie No	No of spp found	Total Plant Population	Margadef (1968)	Odum, Cantlon (1969)	Menhinck (1964)
1.	13	130	5.68	100	1.14
2	5	150	1.84	33.3	0.408
3	7	26	4.25	269.2	1.37
4	8	14	6.10	571.4	2.13

5	13	20	9.23	650.0	2.90
6	15	328	5.57	45.7	0.82
7	8	45	4.24	177.8	1.19
8	11	30	6.77	366.7	2.01
9	3	5	2.89	600.0	1.34
10	4	4	4.98	1000.0	2
11	2	47	0.59	42.6	0.29
12	2	2	3.33	1000.0	1.41
13	10	16	7.47	625.0	2.5
14	15	144	6.51	10.4	1.25
15.	34	199	14.36	170.9	2.411
16.	10	292	3.65	34.2	0.585
17.	10	29	6.15	344.8	1.85
18.	7	45	3.62	155.6	1.044
19.	12	59	6.80	203.4	1.57
20.	24	892	7.79	26.9	0.80
21	12	61	6.16	196.7	1.536
22	*	10,000	-	-	-
23	31	551	10.94	56.3	1.32
24	19	160	8.18	118.7	1.503
25	4	5	4.29	800.0	1.793
26	12	98	5.52	122.4	1.21
27	7	175	2.67	40.0	0.529
28	10	52	5.26	192.3	1.38
29	3	44	1.21	68.2	0.452
30	7	22	4.47	318.2	1.56
31.	**	**	-	-	-
32.	11	23	0.44	478.3	2.29
Tot al	329	3668 for 30 sites		19.4	

* Lodi Garden excluded as tree composition could not be had

** Parsi temple excluded as area, population and composition could not be had.

- + Margalef (1968) $SDI = S-1/ \log N$
- @ Odum, Cantlon and Kornicker(1969) $SDI = S/ 1000$
- \$ Menhinick (1964) $SDI = S/\sqrt{N}$

(Where **N** is the Total population **S** is the No of species found)

Annexure 3: List of species with local and botanical names found in the 32 sites

S.No	Name of the species	Botanical name
1	Vilayati Jhau	<i>Causarina equisetifolia</i>
2	Asoka	<i>Polyanthia longifolia</i>
3	Khajur	<i>Phoenix dactylifera</i>
4	Mango	<i>Mangifera indica</i>
5	Neem	<i>Azadirachta indica</i>
6	Pipal	<i>Ficus religiosa</i>
7	Seemal	<i>Bombax ceiba</i>
8	Khajur	<i>Phoenix humilis</i>
9	Bottle brush/ Cheel	<i>Callistemon viminalis</i>
10	G.mohar	<i>Delonix regia</i>
11	Shisham	<i>Dalbergia sissoo</i>
12	Eucalyptus	<i>Eucalyptus spp</i>
13	Tamarind/ Imli	<i>Tamarindus indicus</i>
14	Amaltas	<i>Cassia fistula</i>
15	Kikar	<i>Acacia nilotica</i>
16	Cycas	<i>Cycas rumphii</i>
17	Cycas	<i>Cycas revoluta</i>
18	Barna	<i>Crataeva religiosa</i>
19	Champa	<i>Pterospermum acerifolium</i>
20	Araceae spp	Araceae
21	Shatute	<i>Morus alba</i>
22	Custard apple	<i>Annona squamosa</i>
23	Kadam	<i>Anthocephalus cadamba</i>
24	Jacaranda	<i>Jacaranda mimosifolia</i>
25	Bamboo	<i>Dendrocalamus strictus</i>
26	Chakundir/ kasood	<i>Cassia siamea</i>
27	Jamun	<i>Syzium cumini</i>
28	China orange/ pomelo	<i>Citrus maxima</i>
29	Kendu	<i>Diosypros cordifolia</i>
30	Peltoforum	<i>Peltoforum ferruginum</i>
31	Saptaparni	<i>Alistonia scholaris</i>
32	Bel	<i>Aegle marmelos</i>
33	Bargad	<i>Ficus benghalensis</i>
34	Gular	<i>Ficus glomerata</i>
35	Guava	<i>Psidium guajava</i>
36	Locart	<i>Eriobotrya japonica</i>
37	Drumstick	<i>Moringa oleifera</i>
38	Pilkhan	<i>Ficus rumphii</i>
39	Rubber	<i>Haevea bragellensis</i>
40	Sal	<i>Shorea robusta</i>
41	Jackfruit	<i>Artocarpus heterophyllus</i>

42	Banana	<i>Musa paradisiaca</i>
43	Jangel jalebi	<i>Pithecollobium dulce</i>
44	Chir	<i>Pinus roxburghii</i>
45	Amla	<i>Embllica officinalis</i>
46	Papari	<i>Pongamia pinnata</i>
47	Anar	<i>Punica grantum</i>
48	Kherni	<i>Manilkara hexandra</i>
49	Morphanki	<i>Thuja spp</i>
50	Mohansiri	<i>Acacia auriculiformis</i>
51	Giloe	<i>Tinospora malabarica</i>
52	Pakar	<i>Ficus infectoria</i>
53	Mahua	<i>Madhuca indica</i>
54	Arjun	<i>Terminalia arjuna</i>
55	Lemon	<i>Citrus limon</i>
56	Hybiscus	<i>Hybiscus sinensis</i>
57	Chilbil	<i>Celosia argentea</i>
58	Harsingar	<i>Nycanththes arbor tristis</i>
59	Mehndi	<i>Lawsonia inermis</i>
60	Bakain	<i>Melia azadarach</i>
61	Ber	<i>Zizyphus spp</i>
62	Puttranjeva	<i>Puttranjeva roxburghii</i>
63	Sita Asoka	<i>Saraca indica</i>
64	Duranta	<i>Duranta plumeri</i>
65	Gardenia	<i>Gardenia turgida</i>
66	Flame flower	<i>Ixora coccinea</i>
67	Satparni	<i>Despodium gangetium</i>
68	Dhauri	<i>Lagerstroemia parviflora</i>
69	Pudina	<i>Hamelia patens</i>
70	Bougainvillae	<i>Bougainvillae spectabilis</i>

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