



DEVELOPING SAPLINGS IN DISPOSABLE PAPER GLASS INSTEAD PLASTIC BAGS

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Abstract: Keeping in view of durability and availability easily at least cost price, since decade, the plastic bags are being used for developing saplings from seeds, cuttings of stem/ branches/ twigs of endemic and threatened species in Government and Private nurseries for mass plantation to develop greenery over vast land areas and/ or restoration of degraded lands/forests, avenue plantation, recreation, etc. In forthcoming years, to meet the requirement of Goal 5 of New York Declaration on Forests, 2014, country-wide mass plantation programme has already been launched to curb tons of ambient CO₂, create congenial environmental conditions for future generation and prevent loss of forest by 2030. Hence, while doing so, if the same is used in huge quantity and left on/along plantation area, it may create nuisance and pollute soil, water, landscape as well as surroundings, may affect drastically to the microorganism and even also causes health hazards to living beings due to its non-biodegradable properties. Thus, to find out an alternate and sustainable means to develop saplings, the biodegradable paper glass was used since Jul, 2019 and grown >5,000 individuals of 30 plant species from seeds by devising a methodology and proper implementation. The devised method is cost effective, convenient in procurement or reuse after any ceremony, plantation and if left unattended in the field, degrade naturally in due course of time.

Keywords: Goal 5, Green environment, Paper glass, Reuse, Saplings.

INTRODUCTION

To have luxurious city life with widen roads, greed for procurement of wide range of commodities, motor vehicles, air conditioners, entertainment and recreational infrastructures, townships, industries, aeroplane / jet, internet/ Wi-Fi etc. people are encroaching in wetland to land by transforming natural habitats/ forests into jungle of concrete (low/high rise buildings), felling huge number of full grown trees, filling wetlands and destructing forests, etc. As a result, since recent past, there is a drastic change in local

and global climatic conditions possibly due to release of tons of ambient/water pollutants including solid/e-wastes may be one of the causative factors for dwindling of the aquatic and terrestrial biodiversity (Kumar and Ashok, 2017; Prakash and Srivastava, 2019; Verma and Prakash, 2020; Arya, 2021).

In order to overcome the problem concerned, most developed and developing countries passed declarations/resolutions and signed agreements during various conferences/ conventions/

summits. In this direction to protect loss of forest cover, restoration, etc., the Ministry of Environment, Forest and Climate Change (MOEF&CC), Government of India under the Paris Agreement outlined India's ambitions and targets in the form of Nationally Determined Contributions (NDCs) and submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 2nd October, 2015 for its implementation. To meet the requirement of Goal 5 of New York Declaration on Forests, the Ministry aim 'to create an additional carbon sink of 2.5 billion to 3 billion tons of CO₂ equivalent through additional forest and tree cover by 2030'. This may be possible, by launching restoration programme over million hectares of degraded landscapes and forest lands with a progressive significant increment in the approach and efforts to be made year-to-year basis till 2030. To achieve this target, the Ministry developed a strategic roadmap and action plan for forestry and may accomplished/ fulfilled by engaging multiple stakeholders (who are involved in research, conservation and management of forests, trees outside forests and related issues) across the country. In this regard, the Ministry initially entrusted such task to the Botanical Survey of India (BSI) to play an important role as a major contributor for the followings:

- Estimation of unutilized land available for mixed native species plantations.
- Preparation of list of trees (to serve as source of seeds) available at the botanic gardens.
- Raising number of seedlings of endemic and threatened species.
- Mapping of specific tree in the forest areas of the concerned States, especially the endemic and endangered species to use them during plantation.
- Estimation for raising number of seedlings and planting materials by BSI and other stakeholders through their botanic gardens maintained across the country for next five years to provide them to the State Forest Departments for plantation on targeted land.

Besides, the State Forest Departments have also been instructed for plantation of saplings by

developing the same in their nurseries (as presently there are >7,500 nurseries existing in Forest Departments) and by receiving from multiple stakeholders including BSI. However, to meet the above target, each Department is facing problem in developing such a huge number of sapling without using nursery poly bags as the same is creating harm to the flora and fauna, polluting to air, water and soil and causing health hazards to animal beings on land and water. During 2018, India led as Global Host of World Environment Day and launched a campaign 'Beat Plastic Pollution' to protect our nature and the planet earth and organized different events at various level. Keeping these into consideration, Central Regional Centre of BSI has taken an initiative and devised a methodology to fulfill the requirement by developing saplings in biodegradable paper glass containers instead of nursery poly bags.

Generally, such paper glass is made of wood chips, wood pulp and by bleaching. To have a paper cup/glass which weighs approx. 10 gram is developed from approx. 33 gram wood pulp. Depending upon uses most manufactures often line or coats the inner surface of glasses by very thin plastic film or waxes to prevent liquid from leaking out or soaking through the paper and decomposes very fast in 3-4 weeks or more depending upon environmental conditions.

Hence, attempt has been made to develop saplings in organically rich soil kept in paper glass (Kumar, 2019) and was watered at regular interval to transform seeding into sapling for plantation to meet the desired goal without harming to the ecological balance and natural habitat of the flora and fauna. Ecological balance is necessary for the survival of all creatures across the globe including humans (Ashok, 2017a; Verma, 2018). This scientific communication deals with the methodology adopted. The described glasses are convenient in use, cost effective, eco-friendly and keep the environment clean and green with the environmental ethics (Ashok, 2017b; Verma, 2019).

MATERIALS AND METHODS

To develop seedlings, seeds of 30 species were collected from field (in and outside premises of

Botanic Garden of Central Regional Centre of Botanical Survey of India, Allahabad on April 03rd and 04th, 2019) as the same remain scattered over land under and nearby trees during the period of dehiscence of mature fruits and/or fruits harvested directly from trees and seeds taken out. Further, seeds were dried under shade, cleaned, segregated and stored for 3 months. As monsoon season started, seeds were sown in organically rich soil in beds of independent plots in between 09.07.2019 and 12.07.2019, watered gently and covered all the plots for two days to prevent the seeds from over watering of rain as well as created extended length of dark period and hot-humid condition. The sprout having 2 cotyledons, young leaves and radicle were taken out from beds of each plot and were re-planted on 22.07.2019 onwards in 4½" high and 3" diameter pot, made up of paper and lined with very thin plastic film and/or may be coated with wax, being used for drinking purposes and commercially available in the local market @ 75 paise to ₹ 1/- only. Before, planting seedlings in paper glass, a hole was made at the bottom of each pot to drain out excess irrigated water. Planted pots were kept in well

aerated shaded area on green net over firm and smooth surface, so as excess irrigated water may not keep the bottom of the paper cup wet for longer period and/or to dry very quickly. To prevent damage to the seedlings from infection/ infestation of bacterial/ fungal/ termites/ insects/ rodent appropriate concentration of respective inhibitors and/or neem khali/ khad may be used.

RESULTS AND DISCUSSION

Based on available secondary data (Table 1), it has been found that >7,500 nurseries are existing in Forest Departments of 16 States viz. Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Meghalaya, Punjab, Rajasthan, Sikkim, Tripura, Uttar Pradesh and Uttarakhand and 2 in Union Territories viz. Dadar and Nagar Haveli and Daman and Diu (MOEF&CC, 2019) and approx. 400 nurseries are existing in Universities and scientific institutions. Among them, most nurseries are having capacity to produce approx. 269 crore saplings and are engaged in development of the same on routine basis.

Table 1: Number of Nurseries in State Forest Departments and their Capacity.

S. No.	Name of State	No. of Nurseries	Capacity to develop Saplings (in Crores)
1.	Andhra Pradesh	1,368	16.000
2.	Arunachal Pradesh	40	0.326
3.	Bihar	944	2.295
4.	Chhattisgarh	291	13.000
5.	Dadar and Nagar Haveli	3	1.895
6.	Daman & Diu	3	0.297
7.	Gujarat	838	15.970
8.	Haryana	193	1.650
9.	Jammu and Kashmir	83	1.240
10.	Karnataka	344	172.000
11.	Madhya Pradesh	169	9.000
12.	Meghalaya	37	0.380
13.	Punjab	220	2.000
14.	Rajasthan	567	5.000
15.	Sikkim	90	0.400
16.	Tripura	52	DNP*
17.	Uttar Pradesh	1,519	26.000
18.	Uttarakhand	783	1.600
	Total	7,544	269.000

*DNP = Data Not Provided

Hence, to add further in number of saplings as desired by the MOEF & CC, Central Regional Centre of BSI made an effort and when monsoon season started, collected seeds were sown in organically rich soil in beds of independent plots in between July 09 and 12, 2019 (Photograph I. 1), watered gently and covered all the plots for two days to prevent the seeds from over watering of rain as well as created extended length of dark period and hot-humid condition. On 3rd day of sowing i.e. 12.07.2019, seeds of 2 plant species namely *Bauhinia purpurea* L. and *Tamarindus indica* L. took shortest time span for germination

followed by seeds of other species namely *Azadirachta indica* A. Juss. (4 days), *Acacia auriculiformis* Benth., *Albizia lebbbeck* (L.) Benth., *Dalbergia sissoo* Roxb., *Melia azedarach* L. and *Oroxylum indicum* (L.) Benth. ex Kurz (6 days) and so on. The maximum time period i.e. 34 days was taken by the seeds of *Terminalia bellirica* (Gaertn.) Roxb. followed by 22 days by *Saraca asoca* (Roxb.) Willd. and *Tabebuia aurea* (Silva Manso) Benth. & Hook.f. ex S.Moore. Out of sown seeds of 30 species, *Mallotus philippensis* (Lam.) Muell. Arg. couldn't germinate (Table 2).

Table 2: Status of saplings developed in Paper Glass in CRC, BSI along with number of days taken in germination and height.

S. No.	Name of the Tree species	IUCN Categories/ Endemic/ Economic and Medicinal plants	Days taken in germination	Height (in inch) measured on	
				22.07.2019	16.08.2019
1	2	3	4	5	6
1.	<i>Acacia auriculiformis</i> Benth. (Fabaceae)	LC 3.1, Eco, M	6	2	7
2.	<i>Adenanthera pavonina</i> L. (Fabaceae)	Orn, Eco, M	12	-	8
3.	<i>Albizia lebbbeck</i> (L.) Benth. (Fabaceae)	Eco, M	6	3	11
4.	<i>Azadirachta indica</i> A. Juss. (Meliaceae)	LC 3.1, Eco, M	4	3	10
5.	<i>Bauhinia purpurea</i> L. (Fabaceae)	LC 3.1, Eco, M	3	4	11
6.	<i>Dalbergia sissoo</i> Roxb. (Fabaceae)	End, Eco	6	2	NS
7.	<i>Gmelina arborea</i> Roxb. (Lamiaceae)	End, Eco, M	18	-	11
8.	<i>Holoptelea integrifolia</i> (Roxb.) Planch. (Ulmaceae)	End, Eco, M	8	NS	NS
9.	<i>Hymenodictyon orixense</i> (Roxb.) Mabb. (Rubiaceae)	Eco, M	9	3	10
10.	<i>Madhuca longifolia</i> (J.Konig) J.F.Macbr. (Sapotaceae)	End, Eco, M	12	-	9
11.	<i>Mallotus philippensis</i> (Lam.) Muell.Arg. (Euphorbiaceae)	Eco	NG	NG	NG
12.	<i>Melia azedarach</i> L. (Meliaceae)	LC 3.1, End, Eco	6	3	9
13.	<i>Mimusops elengi</i> L. (Sapotaceae)	End, Eco, M	18	2	8
14.	<i>Nyctanthes arbor-tristis</i> L. (Oleaceae)	End, Eco, M	10	3	11
15.	<i>Oroxylum indicum</i> (L.) Benth. ex Kurz (Bignoniaceae)	End, Eco, M	6	3	10
16.	<i>Pithecellobium dulce</i> (Roxb.) Benth. (Phyllanthaceae)	Secure, Eco, M	15	-	10
17.	<i>Phyllanthus emblica</i> L. (Phyllanthaceae)	End, Eco, M	12	-	8
18.	<i>Pongamia pinnata</i> (L.) Pierre (Fabaceae)	End, Eco, M	16	-	9
19.	<i>Putranjiva roxburghii</i> Wall. (Putranjivaceae)	End, Eco, M	15	-	10
20.	<i>Saraca asoca</i> (Roxb.) Willd. (Fabaceae)	VU 2.3, End, Eco, M	22	-	8
21.	<i>Senegalia catechu</i> (L.f.) P.J.H.Hurter & Mabb. (Fabaceae)	Eco, M	10	2.5	7
22.	<i>Senna surattensis</i> (Burm.f.) H.S.Irwin & Barneby (Fabaceae)	End, Eco, M	9	2	7
23.	<i>Spondias mombin</i> L. (Anacardiaceae)	Eco, M	15	-	10
24.	<i>Tabebuia aurea</i> (Silva Manso) Benth. & Hook.f. ex S.Moore (Bignoniaceae)	Secure, Orn,	22	-	8
25.	<i>Tabebuia rosea</i> DC. (Fabaceae)	Eco	11	-	10.5
26.	<i>Tamarindus indica</i> L. (Bignoniaceae)	LC 3.1, Eco, M	3	5	10
27.	<i>Tectona grandis</i> L. f. (Verbenaceae)	Eco	14	-	7
28.	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn. (Combretaceae)	End, Eco, M	13	-	8
29.	<i>Terminalia bellirica</i> (Gaertn.) Roxb. (Combretaceae)	End, Eco, M	34	-	11
30.	<i>Ziziphus mauritiana</i> Lam. (Rhamnaceae)	End, Eco, M	15	-	6

CRC = Central Regional Centre, BSI = Botanical Survey of India, IUCN = International Union for Conservation of Nature (IUCN, 2021), No. = Number, Orn = Ornamental, Eco = Economic, M = Medicinal, End = Endemic, LC = Least Concern, - = Germinated after due date, V = Vulnerable, NS = Not Survived, NG = Not Germinated



Photographs I. (L-R) : 1. Preparation of plot; 2 - 4. Ten days old seedlings with cotyledons and young leaves of *Oroxylum indicum* (L.) Benth. ex Kurz, *Tamarindus indica* L. and *Tabebuia rosea* DC. respectively; 5. Hole made in Paper Glass to drain out excess water; 6. Paper glasses; 7. Men at work and 8. Seedlings of 36 days old



Photographs II. (L- R) : 1. Paper glasses infested by deteriorating bacteria/fungi or damaged by termites/insects; 2 and 3. Green net used to keep bottom of paper glasses dry to prevent growth of bacteria and fungi; 4- 6. Two months old planted paper glasses kept in another paper glass for further development and 7. and 8. Six months old saplings of size 1.5 to 2.0 ft. of *Spondias mombin* L. and *Gmelina arborea* Roxb. respectively ready for plantation.

After 10 days of sowing, the height of seedlings of 13 species having 2 cotyledons and/or young leaves ranged from 2 to 5 inches were taken out from beds of each plot and were re-planted in 4½" high and 3" diameter paper glass (containing 60:40 ratio of soil and dung enriched organic manure respectively) depicted in Photograph I. (2-7), used for drinking purposes and commercially available in the local market @ 75 paise to ₹ 1/- only on 22.07.2019 onwards. Further, after 26 days (*i.e.* on 16.08.2019) from re-plantation was carried out on 22.07.2019, the height of survived seedlings were measured which ranged from 6 - 11 inches (Photograph I. 8). By this time in most paper glasses the top/rim of the pots found good in shape, however, bottom of some of the pots get damaged possibly due to continuously wet/rain which may influenced occurrence of deteriorating fungi, bacteria, termites, insects (Photograph II. 1), and/or obviously joints detached and filled soil and plants started coming out. So, such planted pots were kept into a fresh new paper glass and placed over green net (Photograph II. 2-6) for further nursing/development of the saplings. By this time such seedlings were turned into saplings and root network also form properly which may bind the soil within the pot. During the period, if any sapling is required to be taken out from its place or lot of saplings, the base of respective sapling including paper glass were taken out carefully and kept in another paper glass immediately. In case, if excessive soil from root network comes out, fresh soil may be added in the new paper glass containing the saplings.

During 6th months from date of re-plantation in paper glass, all saplings attain a reasonable height ranging from 18 - 24 inches (1.5 to 2.0 ft as depicted in Photograph II. 7 and 8) and root network also develop luxuriantly and become suitable for afforestation in degraded forest land, avenue plantation, recreational and/or in desired landscape areas, etc. By this time, most paper glass starts degrading and if require to extend further time period for its growth/storage for future plantation programme, the same plant may be placed once again in another new paper glass. In this manner, again the new paper glass will provide support for its growth for another 3 months. Besides, if developed sapling is made part of any plantation programme, may be

planted along with paper glass. Such act, if adopted may not only help in preventing littering around the plantation area or land but may overcome one of problem of soil pollution. As after plantation, the intact paper glass, may deteriorate naturally in due course of time and provide primary organic nutrient directly to the planted saplings for its further growth.

To get good and/or desired results, few precautions are essential and required to be followed:

- Protect the potted saplings from termites, insects and deteriorating fungi/bacteria, rodents and/or any other interference.
- Check on excess watering, careful handling, de-weeding.
- Keep on changing each paper glass after every 3 month if one is planning for plantation in future.
- Use green net or any perforated sheets to place potted glasses over firm and plane/ smooth surfaces to facilitate the base of the paper glasses to get dry very quickly resulted longevity of the glasses from early deterioration may increase and reduce the chances of infection/infestation of bacteria, fungi, insects/termites, etc.

In this way, by using 2 or 3 paper glass during the entire period of 6 months or more, it may cost ₹1.50 to ₹ 2.0 only which is less than the cost of earthen pots (costs usually ₹ 5/- onwards and are also not easily available in open market). Thus, to protect our mother earth from adverse effect/impacts caused by the nursery poly bags if left unattended in the nursery/field after plantation, spending of ₹1.50 to ₹ 2.0 for developing a sapling may not be over burden and may be borne by any one.

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