REPORT ON ASSESSMENT OF BIODIVERSITY ENHANCEMENT PROJECTS IN APOLLO TYRES CAMPUS, PERAMBRA AND KALAMASSERY

Report submitted to:

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Final Report

APOLLO TYRES FOUNDATION

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Contents

SECTION-I

BIODIVERSITY ENHANCEMENT PROJECTS AT APOLLO TYRES CAMPUS, PERAMBRA & KALAMASSERY

INTRODUCTION

Biodiversity, as the name indicates diversity in the biosphere. This diversity forms a support-system for the growth and development of human beings and other organisms. But nowadays biodiversity is declining in an unprecedented rate and the pressures driving this decline are intensifying. As biodiversity is the major contributor of raw materials for most of the industries, it is high time that Corporates take the responsibility of ensuring the sustainability of ecosystem and ecosystem services. The COP27 ended with an ambition to tackle the global climate change and for that each state, country and community has to take stringent decisions and actions.

Biodiversity enhancement programs are essential in industrial and urban areas to mitigate the negative impacts on biodiversity by conserving and improving existing biological diversity. Through the implementation of the biodiversity enhancement project at Apollo Tyres, the company has been enabling to establish a way to integrate biodiversity to the business, thereby providing a mechanism for improving Apollo's performance in relation to biodiversity and ecosystem services. It will also demonstrate the company's contribution to corporate responsibility, enhance Apollo's image in the community and its responsibilities towards nature. As a multi-national tyre dealer, performing business in a greener way differentiates Apollo's business tactics from other competitors and improves Apollo's reputation.

Greening of industries is an added responsibility especially in the event of global phenomena like climate change. The ultimate strategic goal of the enhancement programme is to improve the status of biodiversity inside the Apollo campus, Perambra and Kalamassery and its surrounding areas. Apart from enhancing ecosystem services by increasing green cover and faunal diversity in the region, it will also become an effective education tool. Moreover, it reduces atmospheric carbon level through improved biological carbon sequestration. By ensuring the participation of employees and community members in the implementation process, companies' linkage to the employees and community will be strengthened. Restoring biodiversity also increases the aesthetic beauty of the campus and can provide a blissful environment to the workers as well as to the visitors. Apollo Tyres is thus trying to achieve its goals through nature-based solutions.

Biodiversity Enhancement Programmes (BEP) include establishment of butterfly garden, fruit-tree garden, medicinal garden, nectarine garden, wild tree garden, star garden, bamboo garden, apiculture farm, bird garden, composting facilities, *etc.* which will not only improves the aesthetic beauty but also enhance the biodiversity of the campus.

BEP Projects were implemented both at Perambra and Kalamassery campuses of Apollo tyres; the following projects are existing:

SI.NO	PROJECT		IMPLEMENTED ON			
			PERAMBRA	Current status 2022	KALAMASSERY	Current status 2022
1	Butterfly garden	I	2014-2015	Present	2014-2015	Present
		II	2016 - 2017	Present	--	
		III	2018-2019	Present	--	
2	Fruit tree garden		2014-2015	Present	2014-2015	Present
3	Composting facilities		2014-2015	Present	2014-2015	Present
4	Medicinal garden		2016 - 2017	Present	--	
5	Snake bite repellent plants		2014-2015	Present	2014-2015	
6	Apiculture		2014-2015	Present	--	
7	Nectarine garden		2017-2018		--	
8	Bird garden		--		2014-2015	
9	Backside slope beautification		--		2016 - 2017	
10	Green cover enhancement		--		2017-2018	Present

OBJECTIVES

1. To assess the current status (2022) of BEP Projects at Perambra and Kalamassery with respect to 2018 – 2019 (bench mark data)
2. To suggest strategies and practical suggestions to improve and ensure sustainability.

METHODOLOGY

Study period: One month (Aug15 to Sep15)

The assessment study was conducted through onsite survey of each project by field staff. The status of general maintenance biodiversity of respective gardens; maintenance protocol *etc*. were evaluated. All such assessment were made with respect to the objectives of such gardens, and bench mark data in 2018-2019.

RESULT AND DISCUSSION

PERAMBRA

I. BUTTERFLY GARDENS

The Apollo Campus at Perambra has three butterfly gardens. The low maintenance of the park has degraded two among these gardens. Many plants that were planted in the butterfly garden was destroyed due to negligence and lack of proper maintenance. Even repellent plants are planted in the garden too.

1. Butterfly garden near entrance

The butterfly garden that is situated near the main entrance is the well maintained among the three. This has resulted in the increased diversity of butterflies in this garden, while compared to other gardens inside the campus.
Even though it is well maintained, some plants like Cristina (*Syzygium campanulatum),* etc. are planted in the gardens, which makes a repellency against the butterflies. Compared to 2018 – 2019, the butterfly diversity is very less in the gardens (Table 2).

Fig. 1 The butterfly garden present near the ATF Entrance at Perambra.

Table 1. The nectarine and host plants of the butterfly garden at Perambra Campus (Entrance) is given below:

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status
1	*Tabernaemontana divaricata var.*	CRAPE JASMINSE (MINIATURE)	60+	55
2	*Cuphea hyssopifolia*	CUPHEA	50+	30
3	*Jatropha spp.*	JATROPHA	6	4
4	*Plumbago auriculata*	PLUMAGO	5	4
5	*Stachytarpheta jamaicensis*	AFRICAN BLUE SPIKE	20+	20+
6	*Ixoracoccinea*	IXORA MINIATURE	40+	32
7	*Melastoma malabathricum*	MELASTOMA	5+	3
8	*Plumeria pudica*	PLUMERIA	5	4
9	*Clerodendrum paniculatum*	CLERODENDRUM	5	4
10	*Ixora coccinea*	IXORA BIG	20+	17
11	*Bamboo spp.*	BAMBOO	1	1
12	*Cinnamom malabatrum*	CINNOMON	1	1
13	*Mangifera indica*	MANGO TREE	1	1
14	*Cassia fistula*	GOLDEN FLOWER	1	1

		TREE		
15	*Mussaenda philippica*	MUSSANDA	2	2
16	*Nerium oleander*	OLEANDER	4	4
17	*Murraya koenigii*	CURRY LEAF	1	1
18	*Lantana camara*	LANTANA	30+	27
19	*Citrus spp.*	LEMON	1	1
20	*Pongamiapinnata*	PONGAMIA	1	1
21	*Hydrangea macrophylla*	HYDRANGEA	3	1
22	*Crotalaria retusa*	CROTALARIA	15+	10
23	*Pentas lanceolata*	PENTAS	10+	6
24	*Hibiscus rosa-sinensis*	HIBISCUS	5	8
25	*Crossandra infundibuliformis*	CROSSANDRA	5	6
26	*Syzygium campanulatum*	CHRISTINA	0	1
27	*Jasminum sambac*	JASMINE	3	1
28	*Calotropis gigantea*	GAINT MILK WEED	2	1
29	*Cycas circinalis*	CYCAS	1	1
30	*Crateva magna*	LARGE GARLIC PEAR	1	1
31	*Ocimumbasiicum*	ORNAMENTAL OCIMUM	0	18
32	*Tecoma stans*	TECOMA	1	1
33	*Spathoglottis plicata var.*	GROUND ORCHID	0	6
34	*Zinnia linnearis*	ZINNIA	20+	6
35	*Caesalpinia pulcherrima*	PEACOCK FLOWER	1	1
36	*Rosa chinensis*	ROSE	2	1
37	*Abelmoschus moschatus*	*MUSK MALLOW*	5	1
38	*Cordia spp.*	CORDIA	2	0
39	*Aristolochia indica*	INDIAN BIRTH WORT	2	0
40	*Ruta graveolens*	COMMON RUE	3	0
41	*Asclepias curassavica*	INDIAN BLOOD FLOWER	7	0
42	*Flacourtia montana*	MOUNTAIN SWEET THORN	5	0
43	*Palmacea*	PALM	1	0
44	*Plumbago zeylanica*	WHITE PLUMAGO	2	2

Compared to 2018 – 2019, the floral diversity inside the butterfly garden is diminished. Formerly there was 44 plants species present in this garden, but now it has been decreased to 38. The plant diversity has also been decreased, which we can be easily understood from Table 1. Along with this some unwanted exotic plants like Cristina (*Syzygium campanulatum),* Ground Orchid *(Spathoglottis plicata var.)* etc. are planted in the garden, this has createdrepellency

against the butterflies, which may negatively impacted the butterfly diversity.

A butterfly garden should have two kinds of plants- host and nectarine. The common plants which belong to the above two categories, and are suitable for butterfly garden are given in below. Avoid all other plants/ trees from the Butterfly Garden

SI. NO	SCIENTIFIC NAME	COMMON NAME
1.	*Cuphea hyssopifolia*	CUPHEA
2.	*Jatropha spp.*	JATROPHA
3.	*Plumbago auriculata*	PLUMAGO
4.	*Stachytarpheta jamaicensis*	AFRICAN BLUE SPIKE
5.	*Ixora coccinea*	IXORA MINIATURE
6.	*Melastoma malabathricum*	MELASTOMA
7.	*Plumeria pudica*	PLUMERIA
8.	*Clerodendrum paniculatum*	CLERODENDRUM
9.	*Bamboo spp.*	BAMBOO
10.	*Cinnamom malabatrum*	CINNOMON
11.	*Mangifera indica*	MANGO TREE
12.	*Cassia fistula*	GOLDEN FLOWER TREE
13.	*Mussaenda philippica*	MUSSANDA
14.	*Nerium oleander*	OLEANDER
15.	*Murraya koenigii*	CURRY LEAF
16.	*Lantana camara*	LANTANA
17.	*Citrus spp.*	LEMON
18.	*Pongamia pinnata*	PONGAMIA
19.	*Crotalaria retusa*	CROTALARIA
20.	*Pentas lanceolata*	PENTAS
21.	*Hibiscus rosa-sinensis*	HIBISCUS
22.	*Crossandra infundibuliformis*	CROSSANDRA
23.	*Calotropis gigantea*	GAINT MILK WEED
24.	*Crateva magna*	LARGE GARLIC PEAR
25.	*Tecoma stans*	TECOMA
26.	*Zinnia linnearis*	ZINNIA
27.	*Caesalpinia pulcherrima*	PEACOCK FLOWER
28.	*Abelmoschus moschatus*	*MUSK MALLOW*
29.	*Cordia spp.*	CORDIA
30.	*Aristolochia indica*	INDIAN BIRTH WORT
31.	*Ruta graveolens*	COMMON RUE
32.	*Asclepias curassavica*	INDIAN BLOOD FLOWER
33.	*Flacourtia montana*	MOUNTAIN SWEET THORN
34.	*Palmacea*	PALM
35.	*Plumbago zeylanica*	WHITE PLUMAGO
36.	*Aegle marmeloes*	INDIAN BEAL

Table 2. The Butterfly diversity seen in the butterfly garden at Perambra Campus(Entrance) is given below.

Sl.No	Scientific Name	Common Name	Status in 2018-2019	Current status (2022)
1	*Tirumala limniace*	BLUE TIGER	Present	Present
2	*Parantica aglea*	GLASSY BLUE TIGER	Present	Present
3	*Euploea core*	COMMON INDIAN CROW	Present	Present
4	*Junonia iphita*	CHOCOLATE PANCY	Present	Present
5	*Eurema hecabe*	COMMON GRASS YELLOW	Present	Present
6	*Catopsilia pomona*	COMMON EMIGRENT	Present	Present
7	*Papilo polytes*	COMMON MORMON	Present	Present
8	*Pachliopta aristolochiae*	COMMON ROSE	Present	Present
9	*Jamides celeno*	COMMON CERULEAN	Present	Present
10	*Papilio clytia*	COMMON MIME	Present	Present
11	*Hypolimnas missipus*	DANAID EGGFLY	Absent	Present
12	*Appias lyncida*	CHOCOLATE ALBATROUS	Present	Absent
13	*Danaus genutia*	STRIPED TIGER	Present	Absent
14	*Danaus chrysippus*	PLAIN TIGER	Present	Absent
15	*Ypthima baldus*	COMMON FIVE RING	Present	Absent
16	*Papilio demoleus*	LIME BUTTERFLY	Present	Absent
17	*Hypolimnas bolina*	GREAT EGGFLY	Present	Absent
18	*Phalanta phalantha*	COMMON LEOPARD	Present	Absent
19	*Ariadne merione*	COMMON CASTOR	Present	Absent
20	*Acraea terpsicore*	TAWNY COSTER	Present	Absent
21	*Junonia lemonias*	LEMON PANCY	Present	Absent
22	*Tirumala septentrionis*	DARK BLUE TIGER	Present	Absent
23	*Cupha erymanthis*	SOUTHERN RUSTIC	Present	Absent
24	*Graphium agamemnon*	TAILED JAY	Present	Absent
25	*Leptosia nina*	PSYCHE	Present	Absent
26	*Cirrochroa thais*	TAMIL YEOMAN	Present	Absent
27	*Graphium sarpedon*	COMMON BLUE BOTTLE	Present	Absent
28	*Catopsilia pyranthe*	MOTTLED EMIGRENT	Present	Absent
29	*Pachliopta hector*	CRIMSON ROSE	Present	Absent
30	*Junonia atlites*	GREY PANSY	Present	Absent

During 2018-2019 period thirty species of butterflies were identified in this garden, but now it has been lowered to eleven. As mentioned above the usage of unwanted exotic plants that are not suitable for butterfly garden, the usage of pesticides and other chemicals, etc. may resulted in this.

2. Butterfly garden near guest house

The butterfly garden near the guest house is one among those butterfly gardens that are poorly maintained. The low maintenance of the garden has resulted in the growth of weeds, which has inhibited the growth other useful plants. Along with this many plants has been destroyed that created vacant spaces inside the garden. All this has resulted in the butterfly diversity of the garden. Compared to the former garden the butterfly and plant diversity are very low in this garden.

Fig. 2. Butterfly garden at Perambra Campus (Near Guest House)

Table 3. The nectarine and host plants present in the butterfly garden near guest house is given below

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Melastoma malabathricum*	MELASTOMA	20+	2
2	*Cuphea hyssopifolia*	CUPHEA	100+	80
3	*Ixoracoccinea*	IXORA MINIATURE	50+	27
4	*Crotalaria retusa*	CROTALARIA	30+	50 plus
5	*Hibiscus rosa-sinensis*	HIBISCUS	1	1
6	*Plumbago auriculata*	PLUMAGO	3	5
7	*Jatropha*	JATROPHA	10+	3
8	*Ixoracoccinea*	IXORA BIG	30+	11
9	*Caesalpinia pulcherrima*	PEACOCK FLOWER	1	1
10	*Sapindus trifoliatus*	SOAP BERRIES	1	1
11	*Tecoma stans*	TECOMA	1	1
12	*Hydrangea macrophylla*	HYDRANGEA	3	1
13	*Calotropis gigantea*	GAINT MILK WEED	1	1
14	*Cinnamommalabatrum*	CINNOMON	1	1
15	*Flacourtia jangomas*	INDIAN COPFFEE PLUM	1	1
16	*Murraya koenigii*	CURRY LEAF	1	1
17	*Crateva magna*	LARGE GARLIC PEAR	1	1
18	*Aristolochia indica*	INDIAN BIRTH WORT	1	0
19	*Ruta graveolens*	COMMON RUE	2	0
20	*Asclepias curassavica*	INDIAN BLOOD FLOWER	4	0
21	*Flacourtia montana*	MOUNTAIN SWEET THORN	1	1
22	*Palmacea*	PALM	1	0
23	*Plumbago zeylanica*	WHITE PLUMAGO	2	0

The date given in Table 3, shows that the plant diversity inside this butterfly garden has been lowered while compared to 2018-2019 period. It is also evident that the density of plants is decreased drastically and many of the plants has been lost. This has directly impacted the butterfly diversity too. The major reason behind the loss of plants is the low maintenance and negligence. Proper maintenance like watering, weeding out, and fertilizer application are essential for the growth and life of plants. The use of synthetic chemicals as pesticides and fertilizers is also contributes to the decreasing number of butterflies in the garden.

Table 4. The list of butterflies' spotted in the garden near the guest house is given below:

Sl.No	Scientific Name	Common Name	Status in 2018-2019	Current status (2022)
1	*Tirumala limniace*	BLUE TIGER	Present	Present
2	*Euploea core*	COMMON INDIAN CROW	Present	Present
3	*Catopsilia pomona*	COMMON EMIGRENT	Present	Present
4	*Papilo polytes*	COMMON MORMON	Present	Present
5	*Pachliopta aristolochiae*	COMMON ROSE	Present	Present
6	*Jamides celeno*	COMMON CERULEAN	Present	Present
7	*Papilio clytia*	COMMON MIME	Present	Present
8	*Eurema hecabe*	COMMON GRASS YELLOW	Present	Absent
9	*Leptosia nina*	PSYCHE	Present	Absent
10	*Pachliopta hector*	CRIMSON ROSE	Present	Absent
11	*Junonia atlites*	GREY PANSY	Present	Absent
12	*Appias lyncida*	CHOCOLATE ALBATROUS	Present	Absent
13	*Danaus genutia*	STRIPED TIGER	Present	Absent
14	*Danaus chrysippus*	PLAIN TIGER	Present	Absent
15	*Ypthima baldus*	COMMON FIVE RING	Present	Absent
16	*Papilio demoleus*	LIME BUTTERFLY	Present	Absent
17	*Hypolimnas bolina*	GREAT EGGFLY	Present	Absent
18	*Phalanta phalantha*	COMMON LEOPARD	Present	Absent
19	*Ariadne merione*	COMMON CASTOR	Present	Absent
20	*Acraea terpsicore*	TAWNY COSTER	Present	Absent
21	*Junonia lemonias*	LEMON PANCY	Present	Absent
22	*Tirumala septentrionis*	DARK BLUE TIGER	Present	Absent
23	*Cupha erymanthis*	SOUTHERN RUSTIC	Present	Absent
24	*Graphium agamemnon*	TAILED JAY	Present	Absent
25	*Ideopsis vulgaris*	GLASSY BLUE TIGER	Present	Absent
26	*Cirrochroa thais*	TAMIL YEOMAN	Present	Absent
27	*Graphium sarpedon*	COMMON BLUE BOTTLE	Present	Absent
28	*Catopsilia pyranthe*	MOTTLED EMIGRENT	Present	Absent
29	*Junonia iphita*	CHOCOLATE PANCY	Present	Absent

As mentioned earlier the butterfly diversity at the garden near the guest house has been lowered from 29 species to 7 species. This may result in greater ecological imbalances.

3. Butterfly garden near rest house

This was a well-maintained butterfly garden at the Apollo Campus, Perambra. It was started during 2018-2019. However, due to low maintenance and lack of proper care, the garden has lost its life. Several plant varieties totally vanished that created many vacant spaces inside the garden. Such decrease in plant diversity also has negatively impacted the butterfly diversity.

Fig. 3. Butterfly garden at Perambra Campus (Near Rest House)

Fig. 4. Butterfly garden at Perambra Campus (Near Rest House)

Table 5. The nectarine and host plants of the butterfly garden near the rest house is given below:

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Tabernaemontana divaricata var.*	CRAPE JASMINSE (MINIATURE)	350+	300 +
2	*Cuphea hyssopifolia*	CUPHEA	100+	60
3	*Jatropha spp.*	JATROPHA	30+	17
4	*Plumbago auriculata*	PLUMAGO	20+	1
5	*Stachytarpheta jamaicensis*	JAMAICAN BLUE SPIKE	15+	8
6	*Ixora coccinea*	IXORA MINIATURE	200+	113
7	*Melastoma malabathricum*	MELASTOMA	30+	15
8	*Plumeria pudica*	PLUMERIA	3	1
9	*Clerodendrum paniculatum*	CLERODENDRUM	15+	10
10	*Ixora coccinea*	IXORA BIG	30+	23

11	*Bamboo spp*	BAMBOO	2	2
12	*Cinnamom malabatrum*	CINNOMON	2	2
13	*Mangifera indica*	MANGO TREE	10	9
14	*Cassia fistula*	GOLDEN FLOWER TREE	2	2
15	*Mussaenda philippica*	MUSSANDA	2	1
16	*Nerium oleander*	OLEANDER	20+	18
17	*Murraya koenigii*	CURRY LEAF	2	2
18	*Lantana camara*	LANTANA	30+	15+
19	*Citrus spp*	LEMON	2	1
20	*Pongamia pinnata*	PONGAMIA	4	3
21	*Hydrangea macrophylla*	HYDRANGEA	4	3
22	*Crotalaria retusa*	CROTALARIA	40	20

While compared to other gardens the diversity of the garden is the same, but the density of the plants is drastically declined, especially the density of nectarine plants. This will directly decreases the population of butterflies in the garden.

Table 6. The butterflies spotted from the garden is given below:

Sl.No	Scientific Name	Common Name	Current status (2022)
1	*Tirumala limniace*	BLUE TIGER	Present
2	*Euploea core*	COMMON INDIAN CROW	Present
3	*Junonia iphita*	CHOCOLATE PANCY	Present
4	*Hypolimnas missipus*	DANAID EGGFLY	Present

The data regarding the butterfly diversity in this garden after the establishment of the garden is absent. The Table 6 shows the list of butterflies currently seen in the garden butterfly, the butterfly diversity in this garden is very low while compared to other gardens.

In brief, low maintenance, absence of proper care, lack of knowledge on the concept of butterflies, use of chemical pesticides and fertilizers, decrease in the host and nectarian plant species and introduction of repellent plants species are the major reasons for the diminishing population of butterflies.

II. MEDICINAL GARDEN

Medicinal garden is another thematic garden developed at ATF Campus at Perambra. It was established during 2018-2019. During that time, there were 53 species of medicinal plants, but now it is declined to 24. Many plants that were lost was not replanted, but on the other hand repetition of plant species is noticed (Table 7). The low maintenance of these plants hasresulted the loss of plants and the destruction of garden.

Fig. 5. Medicinal Garden at Perambra Campus

Table 7. List of medicinal plants present in the garden is given below:

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Oxalis corniculata*	INDIAN SORREL	1	1
2	*Coleus amboinicus*	INDIAN BORAGE	1	1
3	*Vitis quadrangularis*	VELDT GRAPE	1	3
4	*Alpinia galanga*	GREATER GALANG	1	2
5	*Ipomea marginata*	PURPLE HEART GLORY	1	2
6	*Bauhinia acuminata*	WHITE ORCHID TREE	0	1
7	*Justicia gendarussa*	BLACK MALABAR NUT	1	1
8	*Clitoria ternatea*	BUTTERFLY PEA	1	4
9	*Gymnema sylvestre*	SUGAR DESTROYER	2	1
10	*Justicia adhatoda*	MALABAR NUT	1	1
11	*Elateria cardamom*	CARDAMOM	1	2
12	*Curcuma longa*	TURMERIC	1	1
13	*Wrightia tinctoria*	PALA INDIGO	0	1

14	*Piper longum*	LONG PEPPER	2	1
15	*Tylophora asthmatica*	INDIAN IPECAC	1	2
16	*Piper nigrum*	BLACK PEPPER	1	1
17	*Ocimum sanctum*	SACRED BASIL	0	1
18	*Zingiber officinale*	GINGER	1	1
19	*Eupatorium triplinervis*	WATER HEMP	1	2
20	*Acorus calamus*	ACORUS	0	1
21	*Plumago rosea*	FIRE PLANT	1	1
22	*Salacia reticulata*	SALARETIN	1	1
23	*Adenanthera pavonina*	CIRCASSIAN TREE	0	1
24	*Simarouba glauca*	PARADISE TREE	0	1
25	*Plumago zeylanica*	WHITE PLUMAGO	2	0
26	*Solanum violaceum*	SOLANUM	1	0
27	*Abrus precatorius*	ROSARY PEA	1	0
28	*Aloe vera*	ALOE	1	0
29	*Indigofera tinctoria*	TRUE INDIGO	1	0
30	*Eryngium foetidum*	MEXICAN CORIANDER	1	0
31	*Eupatorium ayapana*	AYAPANA	1	0
32	*Eliptica alba*	FALSE DAISY	1	0
33	*Pseudarthria viscida*	STICKY DESMODIUM	1	0
34	*Rauwolfia serpentina*	INDIAN SNAKEROOT	1	0
35	*Curculigo orchioides*	GOLDEN EYE GRASS	1	0
36	*Acacia catechu*	BLACK CUTCH	1	0
37	*Vitex negundo*	CASTE TREE	1	0
38	*Cardiospermum halicacabum*	BALOON VINE	1	0
39	*Calotropis gigantean*	GAINT MILK WEED	1	0
40	*Ruta graveolens*	COMMON RUE	1	0
41	*Abelmoschus moschatus*	MUSK MALLOW	1	0
42	*Hemidesmus indicus*	INDIAN SARSAPARILLA	1	0
43	*Catharanthus roseus*	ROSE PERIWINKLE	1	0
44	Sida rhombifolia	SIDA	1	0
45	Trichopus zeylanicus	AROGYA PACHA	1	0
46	*Asparagus racemosus*	ASPARAGUS	1	0
47	*Costus pictus*	COSTUS	1	0
48	*Centella asiatica*	ASIATIC PENNYWORT	1	0
49	*Elephantopus scaber*	ELEPHANT FOOT	1	0
50	*Phyllanthus amarus*	PHYLLANTHUS	1	0
51	*Bacopa monnieri*	WATER HYSSOP	1	0
52	*Hemigraphis colorata*	RED IVY	1	0
53	*Biophytum sensitivum*	LITTLE TREE PLANT	1	0
54	*Vernonina cinerea*	LITTLE IRON WEED	1	0
55	*Kaempferia galanga*	KAEMPFERIA	1	0

56	*Desmodium gangeticum*	DESMODIUM	1	0
57	*Scoparia dulcis*	GOAT WEED	1	0
58	*Emilia sonchifolia*	EMILIA	1	0
59	*Aerva lanata*	MOUNTAIN KNOTGRASS	1	0

III. FRUIT TREE GARDEN

Fruit tree garden is another thematic garden established at the ATF Campus at Perambra. While comparing to other thematic gardens, the fruit tree garden is in a healthy condition. The majority of trees that were planted at the garden started to flower as well as produce fruits. **13 percent of trees are lost for developmental projects in the campus. In brief, fruit tree garden is now self-maintained (as the trees have grown), and 87% of trees have been survived. It is noted that there is no maintenance is done for the trees, except giving chemical fertilizers, once in an year.**

Fig. 6. Fruit tree garden at Perambra Campus

Fig. 7. Picture of a fruit tree that was removed from the garden

Table 8. The List of fruit trees in the garden

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Artocarpus heterophyllus*	JACK FRUIT TREE	10	10
2	*Averrhoabilimbi*	CUCUMBER TREE	2	2
3	*Tamarindus indica*	TAMARIND	5	5
4	*Garcinia mangostana*	MANGOSTEEN	2	2
5	*Syzygium caryophyllatum*	SOUTH INDIAN PLUM	2	2
6	*Syzygium cumini*	BLACK PLUM	7	7
7	*Spondias pinnata*	WILD MANGO	5	4
8	*Ficus racemosa*	CLUSTER FIG	5	5
9	*Phyllanthus acidus*	STAR GOOSEBERRY	3	3
10	*Mangifera indica*	MANGO TREE	19	17
11	*Terminalia catappa*	INDIAN ALMOND	5	1
12	*Annonamuricata*	SOURSOP	5	1
13	*Annona squamosa*	CUSTARD APPLE	2	2
14	*Psidiumguajava*	GUAVA	8	7
15	*Mimusopselengi*	BULLETWOOD	5	1
16	*Moringa oleifera*	DRUM STICK TREE	1	1
17	*Manilkara zapota*	CHIKU	2	2
18	*Phyllanthus embilica*	INDIAN GOOSEBERRY	2	2
19	*Bunchosia glandulifera*	PEANUT BUTTER	1	1
20	*Syzygium aqueum*	ROSE APPLE	1	1
21	*Nephelium lappaceum*	RAMPUTAN	1	1
22	*Averrhoa carambola*	STAR FRUIT	1	1
23	*Carissa carandas*	CHERRY	2	2
24	*Flacourtia jangomas*	LUVI	2	0
25	*Citrus limetta*	SWEET LEMON	1	0
26	*Eugenia uniflora*	SURINAM CHERRY	3	0
27	*Pouteria campechiana*	EGG FRUIT	5	0
28	*Syzygium malaccense*	MALAY APPLE	1	0
29	*Eugenia candolleana*	PLUM TREE	1	0

29 species of plants were there during the initial period of the fruit tree garden. But now it is lowered to 23. **Among all gardens, fruit tree garden is the most survived one. Trees are now self growing and there is no need of maintenance.**

IV. ZERO BUDGET NATURAL FARMING (ZBNF)

Earlier 5-6 kinds of vegetables in good quantity and quality were maintained. The produce were given to the canteen also. But, now only amarathus is present in ZBNF. Maintenance is very poor. The quantity of crop produce is not disclosed by the concerned personals.

Fig. 7.

Table 9. The list of Vegetables present in the ZBNF at Perambra is given below:

SI. NO	VEGITABLE	No of plants present in 2018-2019	Current status (2022)
1	SPINACH (green)	Present	Present
2	SPINACH (red)	Present	Present
3.	CABBAGE	Present	Absent
4.	CAULIFLOWER	Present	Absent
5.	TAPIOCA	Present	Absent
6.	BRINJAL	Present	Absent
7.	LADIES FINGER	Present	Absent

V. APICULTURE UNIT

An apiculture unit was established at Perambra campus. Initially 28 colonies were present in the area, but now it is lowered to 6. Nearly 80% of the colonies are abandoned now. It is mainly due to lack of maintenance and proper care. Out of the 6 colonies present, two are in very weak condition. Also we noticed that aimed at prophylaxis they are providing someantibiotics along with the feed against disease. This is not an organic way of apiary management. The resultant honey may have traces of antibiotics too.

Fig. 8. Apiary at Apollo campus

Fig 9. Inspection of colonies at Apollo Tyres Campus, Perambra

VI. NECTARINE PLANT GARDEN

Nectarine plant garden is totally vanished due to lack of maintenance. The given image shows the current situation of the garden. Nectraine garden was intended top provide feed to Honey bees mainly.

Fig 10. Nectarine garden at Apollo Tyres Campus, Perambra

Conclusion on Thematic Gardens

Thematic gardening is a globally accepted strategy for the urban biodiversity conservation. All the five kinds of gardens were implemented imbibing the basic principles of eco conservation. Because of the lack of the knowledge on such practices among the current team of garden maintenance is the major cause of depletion of studied thematic gardens. Besides, ecofriendly management of such gardens also envisaged such as water wise planting, promotion of native species, avoiding exotic plants, non use of chemical fertilizers and pesticides etc. All these conceptual practices have been ignored. As a result, in all the gardens plant and animal diversity has been significantly reduced. Even though, some of the gardens may look like well maintained, the expected diversity enhancement not been resulted.

VII. COMPOSTING UNIT

Composting units are established in the Apollo Tyres Campus at Perambra. They are still functional, but not properly. Currently the composting unit is used just as a waste pit, without proper care and usage. On a regular basis they are putting the dried leaves and bio wastes, but it is not in a position to become compost as the required conditions are absent. . Composting inoculum is not used for composting, which is an effective way to fasten the compostingprocess of organic manner.

Fig 11. Composting Unit at Apollo Tyres Campus, Perambra

KALAMASSERY

I. BUTTERFLY GARDEN

The former butterfly garden which was built by TIES was removed and constructed another butterfly garden at another location. But the garden was constructed not based on the conceptual frame work for a butterfly garden (host and nectarian plants). Currently, there are only very few plants inside this garden that supports butterflies. Plant diversity of plants is present in the garden. This has resulted in the lowering of butterfly diversity.

Fig 11. The newly constructed butterfly garden at Apollo Campus, Kalamassery.

Table 10. The nectarine and host plants present in the newly constructed butterflygarden at Kalamassery is given below:

SI. NO	SCIENTIFIC NAME	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Nerium oleander*	OLEANDER	10	2
2	*Citrus spp*	LEMON	1	1
3	*Cinnamom malabatrum*	CINNOMON	1	1
4	*Murraya koenigii*	CURRY LEAF	1	1
5	*Cuphea hyssopifolia*	CUPHEA	50+	30+

6	*Crotalaria retusa*	CROTALARIA	10	10+
7	*Plumbago auriculata*	PLUMAGO	3	15+
8	*Lantana camara*	LANTANA	15	2
9	*Clerodendrum paniculatum*	CLERODENDRUM	5	3
10	*Hibiscus rosa-sinensis*	HIBISCUS	2	2
11	*Ixora coccinea*	IXORA MINIATURE	15	6
12	*Mussaenda philippica*	MUSSANDA	1	0
13	*Stachytarpheta jamaicensis*	AFRICAN BLUE SPIKE	15	0
14	*Calotropis gigantea*	GAINT MILK WEED	2	0
16	*Caesalpinia pulcherrima*	PEACOCK FLOWER	5	0
17	*Crateva magna*	LARGE GARLIC PEAR	1	0
18	*Jasminum sambac*	JASMINE	8	0
19	*Pentas lanceolata*	PENTAS	10	0
20	*Sapindus trifoliatus*	SOAP NUT	1	0
21	*Cordia spp.*	CORDIA	2	0
22	*Aristolochia indica*	INDIAN BIRTH WORT	1	0
23	*Ruta graveolens*	COMMON RUE	3	0
24	*Asclepias curassavica*	INDIAN BLOOD FLOWER	4	0
25	*Flacourtia montana*	MOUNTAIN SWEET THORN	1	0
26	*Palmacea*	PALM	1	0
27	*Plumbago zeylanica*	WHITE PLUMAGO	6	0

It is evident from the table that the plant diversity and density has been diminished while comparing with that of 2018-2019. Formerly there was 27 species of plants in the butterfly garden, but now in the newly constructed garden there are only 11 species. This has impacted the butterfly diversity.

Table 11. List of butterflies spotted in the garden

Sl.No	Scientific *Name*	Common Name	Status in 2018-2019	Current status
1	*Tirumala limniace*	BLUE TIGER	Present	Present
2	*Euploea core*	COMMON INDIAN CROW	Present	Present
3	*Papilo polytes*	COMMON MORMON	Present	Present
4	*Pachliopta aristolochiae*	COMMON ROSE	Present	Absent
5	*Jamides celeno*	COMMON CERULEAN	Present	Absent
6	*Catopsilia pomona*	COMMON EMIGRENT	Present	Absent
7	*Junonia iphita*	CHOCOLATE PANCY	Present	Absent
8	*Eurema hecabe*	COMMON GRASS YELLOW	Present	Absent
9	*Leptosia nina*	PSYCHE	Present	Absent

10	*Pachliopta hector*	CRIMSON ROSE	Present	Absent
11	*Junonia atlites*	GREY PANSY	Present	Absent
12	*Appias lyncida*	CHOCOLATE ALBATROUS	Present	Absent
13	*Danaus genutia*	STRIPED TIGER	Present	Absent
14	*Danaus chrysippus*	PLAIN TIGER	Present	Absent
15	*Ypthima baldus*	COMMON FIVE RING	Present	Absent
16	*Papilio demoleus*	LIME BUTTERFLY	Present	Absent
17	*Hypolimnas bolina*	GREAT EGGFLY	Present	Absent
18	*Phalanta phalantha*	COMMON LEOPARD	Present	Absent
19	*Ariadne merione*	COMMON CASTOR	Present	Absent
20	*Acraea terpsicore*	TAWNY COSTER	Present	Absent
21	*Junonia lemonias*	LEMON PANCY	Present	Absent
22	*Tirumala septentrionis*	DARK BLUE TIGER	Present	Absent

From the table it is evident that the butterfly diversity is very poor at the Kalamssery butterfly garden. It is due to the lack of host plants. Formerly 22 species were identified, but it has been lowered to 3 species.

II. FRUIT TREE GARDEN

A fruit tree garden was also built inside the Apollo Tyres Campus at Kalamssery. Initially there were 26 species of fruit trees inside this garden, but now it has been reduced to 12 species. Only 16 percentage of plants are remaining in the fruit tree garden compared to 2018 -2019 status, and rest were removed for civilconstructions.

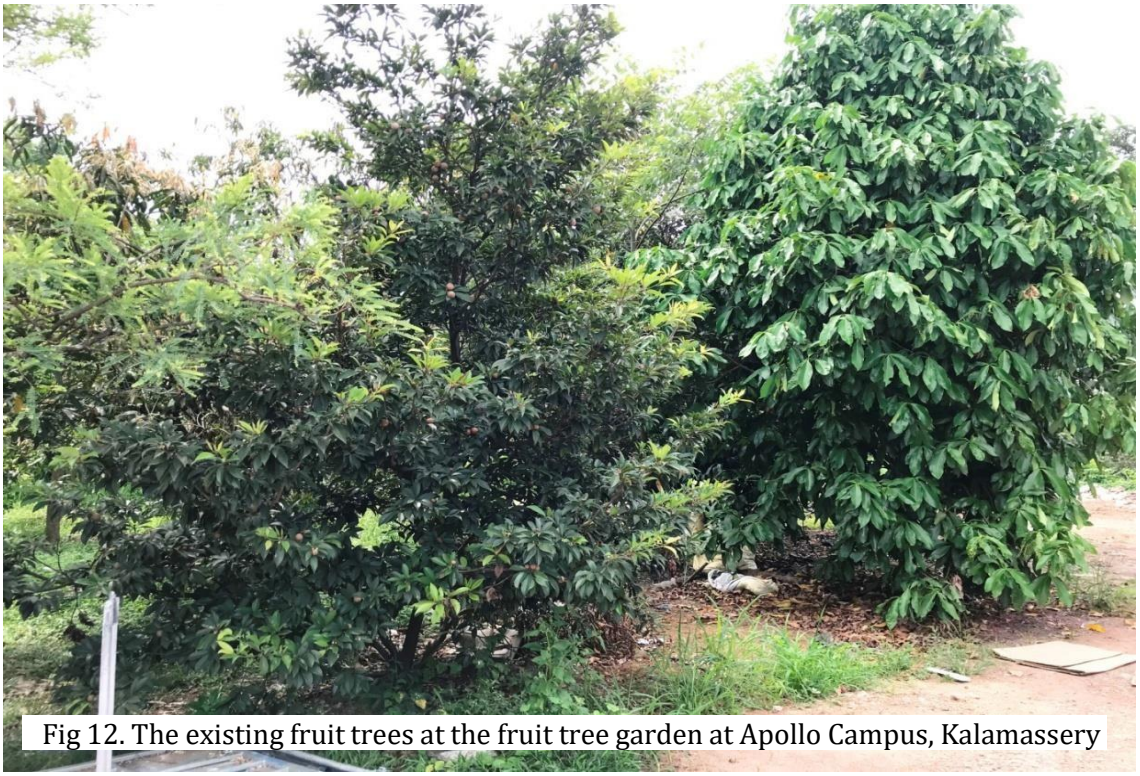


Fig 12. The existing fruit trees at the fruit tree garden at Apollo Campus, Kalamassery

Table 12. The list of fruit trees existing in the fruit tree garden at Kalamssery Apollo Tyres Campus is given below:

SI. NO	SCIENTIFIC *NAME*	COMMON NAME	No of plants present in 2018-2019	Current status (2022)
1	*Phyllanthus embilica*	INDIAN GOOSEBERRY	2	1
2	*Averrhoa bilimbi*	CUCUMBER TREE	3	1
3	*Mangifera indica*	MANGO TREE	7	1
4	*Manilkara zapota*	CHIKU	4	1
5	*Citrus pennivesiculata*	LEMON	3	1
6	*Syzygium cumini*	BLACK PLUM	2	2
7	*Syzygium jambos*	ROSE APPLE	3	1
8	*Annona squamosa*	CUSTARD APPLE	6	1
9	*Citrus maxima*	POMELO	2	1
10	*Artocarpus heterophyllus*	JACK FRUIT TREE	3	1
11	*Tamarindus indica*	TAMARIND	3	1
12	*Garcinia xanthochymus*	SOUR MANGOSTEEN	2	1
13	*Spondias pinnata*	WILD MANGO	3	0
14	Ficus racemosa	CLUSTER FIG	2	0
15	*Phyllanthus acidus*	*STAR GOOSEBERRY*	3	0
16	*Annona muricata*	SOURSOP	3	0
17	*Psidiumguajava*	GUAVA	5	0
18	*Garcinia mangostana*	MANGOSTEEN	4	0
19	*Syzygium aqueum*	ROSE APPLE	3	0
20	*Nephelium lappaceum*	RAMPUTAN	4	0
21	*Flacourtia jangomas*	LUVI	4	0
22	*Citrus limetta*	SWEET LEMON	3	0
23	*Eugenia uniflora*	SURINAM CHERRY	1	0
24	*Pouteria campechiana*	EGG FRUIT	4	0
25	*syzygium malaccense*	MALAY APPLE	1	0
26	*eugenia candolleana*	PLUM TREE	1	0

III. ZERO BUDGET NATURAL FARMING (ZBNF)

ZBNF was built inside the Apollo Tyres Campus at Kalamssery. It is well maintained and in good condition when compared to Perambra Campus. But all these plants lack proper manuring (like cow dung, compost, etc. are providing). The diversity of vegetables is lowered while comparing to 2018-2019.

Fig 13. The ZBNF at Kalamassery Apollo Tyres Campus

SI. NO	VEGITABLE	No of plants present in 2018-2019	Current status (2022)
1.	ELEPHANT FOOT YAM	Present	Present
2.	LADIES FINGER	Present	Present
3.	TOMATO	Absent	Present
4.	ZINGIBER	Present	Present
5.	ASH GOURD	Present	Absent
6.	OKHARA	Present	Absent
7.	BRINJAL	Present	Absent
8.	LONG BEANS	Present	Absent
9.	GREEN CHILLY	Present	Absent
10.	IVY GOURD	Present	Absent
11.	TAPIOCA	Present	Absent
12.	BOTTLE GOURD	Present	Absent
13.	CABBAGE	Present	Absent

IV. COMPOSTING

A composting unit is maintained inside the Apollo Tyres Campus, at Kalamassery. The major waste used here is the canteen waste, especially tea waste. Usage of composting inoculums is also absent here.

Fig 14. Composting Units maintained at Apollo Tyres Campus, Kalamassery.

V. GREEN COVER ENHANCEMENT PROJECT

A green belt of crape myrtle (*Lagerstroemia speciosa*) is established through a long stretch at Apollo Tyres Campus at Kalamassery. All these plants started flowering now. They are providing good shade in the walkway and also enhanced the aesthetic beauty. Now 40 numbers of trees are growing.

Fig 15. The Crape myrtle belt at Apollo Tyres Campus at Kalamassery.

EXECUTIVE SUMMARY

A total of 10 different BEP projects have been implemented and comparison was done, between the present status (2022) and the same of the year of implementation of the respective project. The progress of the following projects were evaluated comparing the bench mark year (implementation) status with that of 2022. The studied projects are butterfly garden (Three at Perambra: 2014, 2016 & 2018; one at Kalamasserry- 2014; medicinal plant garden (one at Perambra only- 2014); fruit tree garden (one each at Perambra & Kalamasserry-both in 2014); snake bite repellent plant belt (one each at Permabra & Kalamasserry-both in 2014); nectarine garden (One at Perambra only-2017); apiculture (one at Perambra only- 2014); Bird garden (2014), backside slope beautification (2016); and Green cover enhancement (2017); Zero Budget Natural farming (one each at Perambra & Kalamasserry-both in 2014); and composting facilities (one at Perambra only-2014).

1. **Butterfly garden**: All the gardens are maintained well. But the density and diversity of butterflies have been significantly reduced (44 to 32). Te major reason is planting non host plants and even repellent plants are in the garden..
2. **Medicinal Plant Gardens**: Plant diversity has been reduced by almost 50%. Low maintenance and replacement of plants of the same species in the garden instead of the lost ones are the key issues identified.
3. **Fruit Tree Garden** : fruit tree garden was started in 2014 and majority of the trees are now fruit bearing. 13% of plants lost in Perambra, whereas heavy loss happened at Kalamassery owing to developmental projects.
4. **Snake repellent plant belt**: It is a totally failed project. Now at both units, very few plants remains. This is not included in the care list of present caretakers.
5. **Nectarine Garden**: Totally failed project. Not a single plant now available. This was meant for supporting apiculture.
6. **Apiculture**: Initially 28 boxes were there. Now only 6. Ill maintained. Even allopathic meidcnes are being used for caring bees!
7. **Zero budget farming**: the diversity and production has been reduced at both units. Now very minimal planting and improper maintenance. Statistics regarding average production was not available.
8. **Back side beautification** : Now nothing is there where the slope was made green with variety of plant cover.
9. **Green cover enhancement**: This is a highly successful project. Almost all the originally planted trees have been grown into shade giving size. At this stage there is no need of any maintenance or caring.
10. **Composting**: It is a failure now. Now the mixed wastes are dumped in the composting pit and neighboring area. Burning of such wastes just nearby to the composting unit was also observed.

CHALLENGES AND RECOMMENDATIONS

- Seasonal planting is not carrying out in any of these gardens, this can only maintain the garden diversity and associated faunal diversity
- Lack of organic manure application is noticed at each gardens. Timely application of organic manure will only retain the life of the plants. It is equally essential for the plant growth, fruiting, etc.
- it is doubtful that plants preferably measures are truly organic. The decreasing the butterfly diversity may be due to that reason too
- It is noticed that exotic plants are used in different gardens, which is against the concept of the project. It will also negatively affect the associated fauna.
- Apiculture units requires proper care and maintenance that will only maintains the health of the apiary units. But the apiary units are poorly maintained in the campus that has resulted in the colony abandonment.
- Biodiversity conservation, water conservation, waste management, soil conservation, etc. was given immense importance in all BEP projects, but now all the projects have been diverted from these concepts.

SECTION-II

SUSTAINABLE WATER USAGE AT CANTEEN, APOLLO TYRES LTD. PERAMPRA CAMPUS, CHALAKUDY, THRISSUR

INTRODUCTION

Currently on an average 167Kl of water has been using daily at the canteen of the company. This forms about 25% of the total domestic water usage (750Kl). Over 2600 persons are using the canteen facilities every day, in three shifts. The main area of water consumption is for periodic cleaning (3 times/day- kitchen, food delivery points, wash and waste bin area; one time/day- canteen food serving area) and washing food, utensils, plates & glasses *etc*; cooking preparation and wash basins.

Our target is to reduce the water usage to 140Kl/day in a phase wise manner with the active participation of all the canteen staff and the user community. Hence, there will be two categories of water conservation strategies are proposed: one with infrastructural modifications and the other on Habitual changes.

Target	: Reducing water usage from 167 Kl to 140 Kl
Target period	: 60 days (infrastructural changes -30 days)

METHODOLOGY

Secondary data was collected from the system authorities. Interaction with system personal also helped to extract accurate information. An online survey was conducted on the attitude, daily consumption of water, knowledge about importance of water conservation, suggestions to conserve water in the canteen *etc*., among the canteen staff. Survey forms were given both in Hindi and Malayalam languages. The data is analyzed and presented. Information were gathered on water usage habit of the respondents at the company as well as at their home.

A short training and interaction session was conducted for the canteen staff in their work intermissions on 24th November 2022, as two batches: at 2-2.30 PM and 4.00 to 4.30 PM. Altogether 49 staff were participated. During the interaction session participants provided valid suggestions for water conservation.

RESULTS & OBSERVATIONS

Survey

Although survey forms were distributed in two languages, no staff members used the Hindi version. 58 staff members put their responses in the online survey sheet. The category of the participants is given in Fig.1. Cleaning staff formed the highest section of participants followed by supply and kitchen staff.

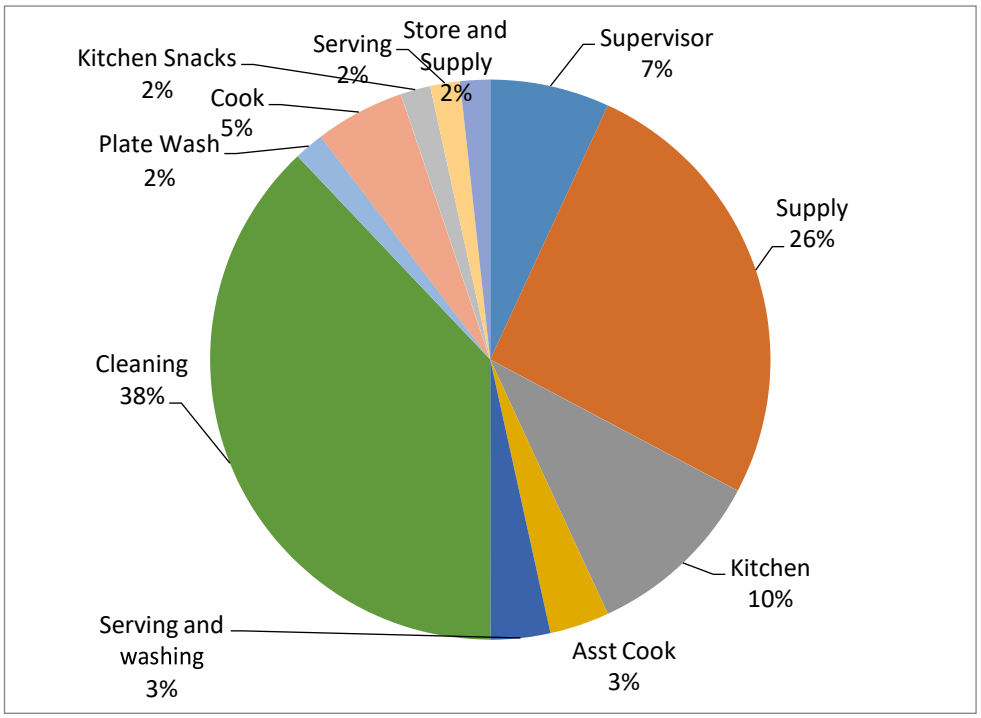
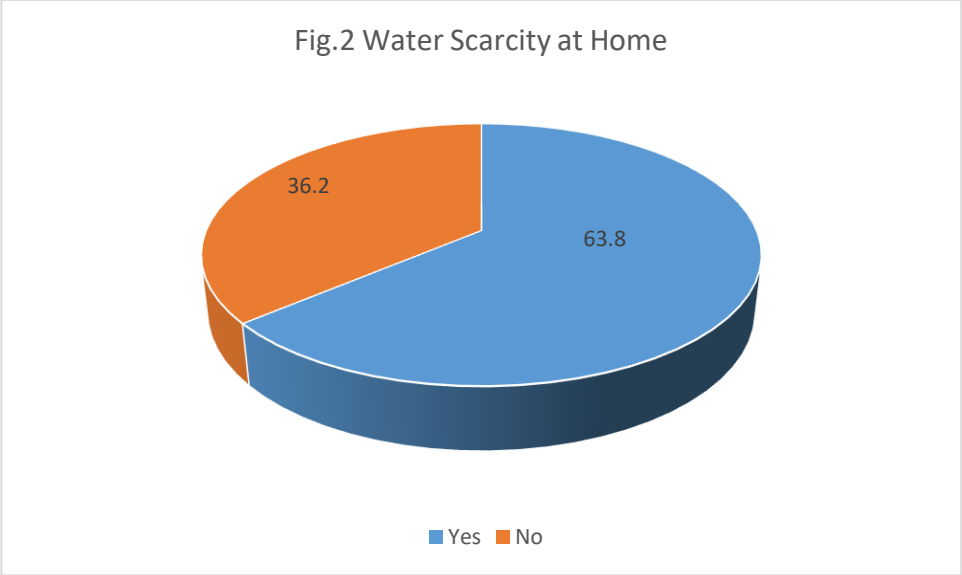
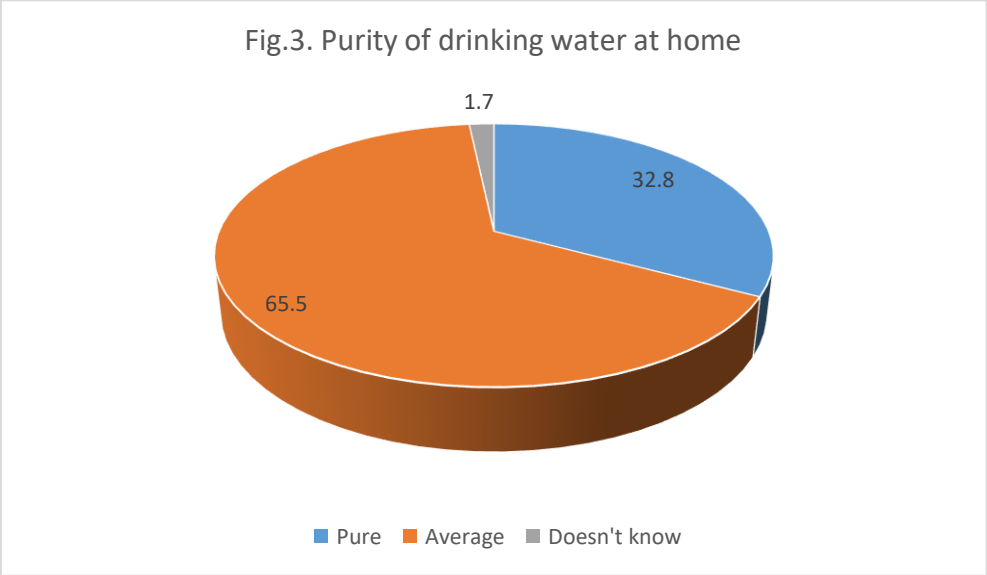


Fig.1. Category of Participants in the survey

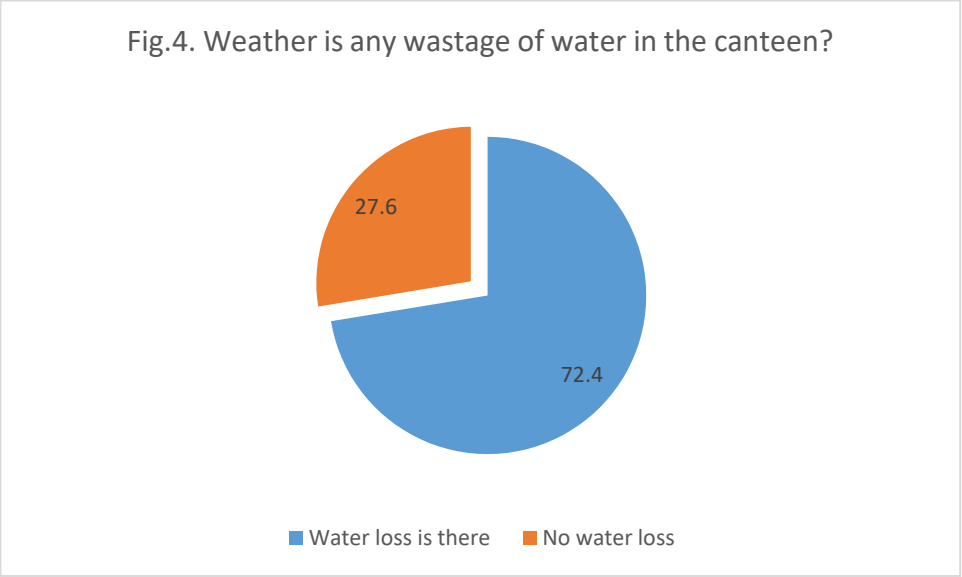
According to the responses, all the participants strongly believe that water should be conserved. This positive attitude paves the route for implementing sustainability measures. 63.8% of the participants have water scarcity in summer at their home. So they knew the value of water (Fig.2).



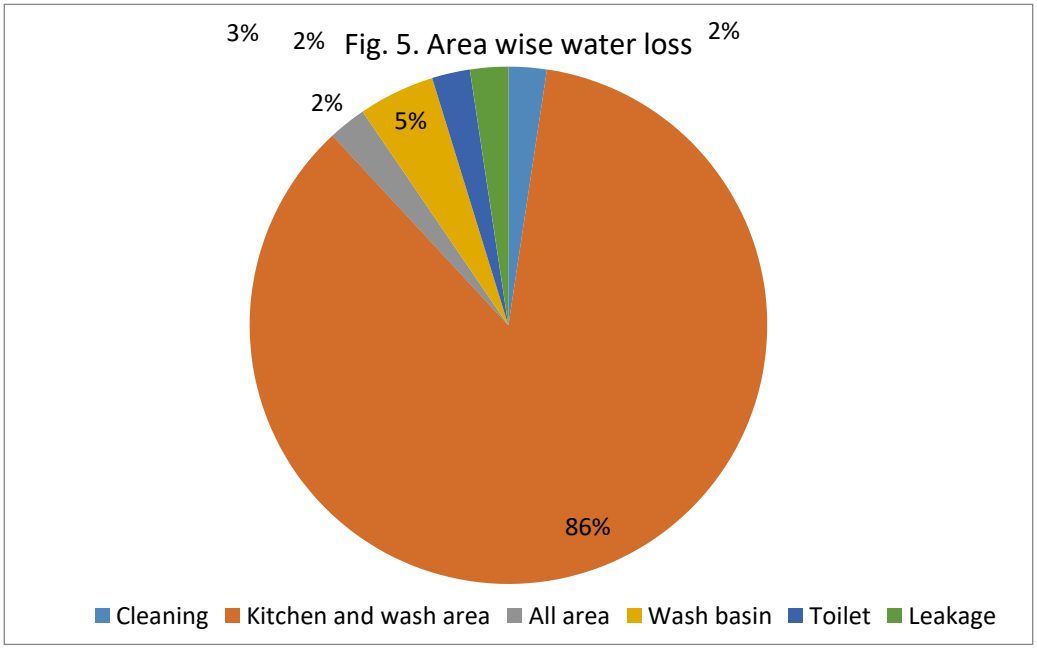


Only 32.8% of the participants believe that the drinking water at their home is pure. 65.5% believe that drinking water is of average quality. 1.7% of the participants doesn't know what standards it has (Fig.3). This again shows the attitude of the community towards quality concerns of the water.

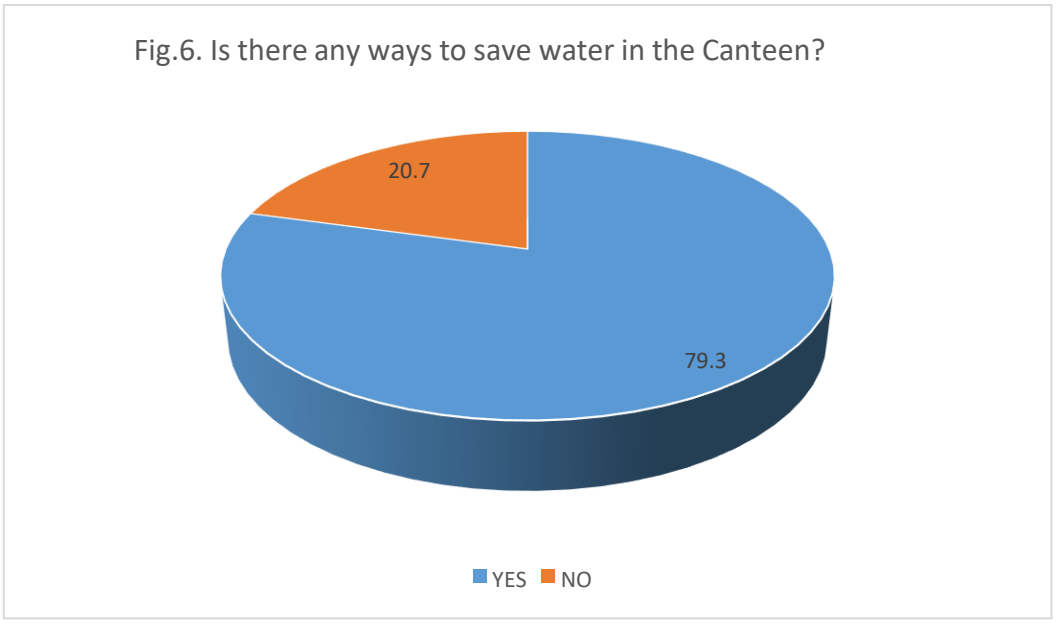
More than half of the participants (55%) have 1000L capacity water tank and they are filling the tank once daily. 40% of the participants have 4 members in their house. This means that on an average participants per head consumption of water at their home (including drinking, bathing, washing, cooking *etc.*) is 250L per day. This is *at par* with the average semi rural consumption of the country, which is less than that of the urban consumption. It should be noted that the maximum water requirement for a person per day is fixed as 70L as per national and international standards.



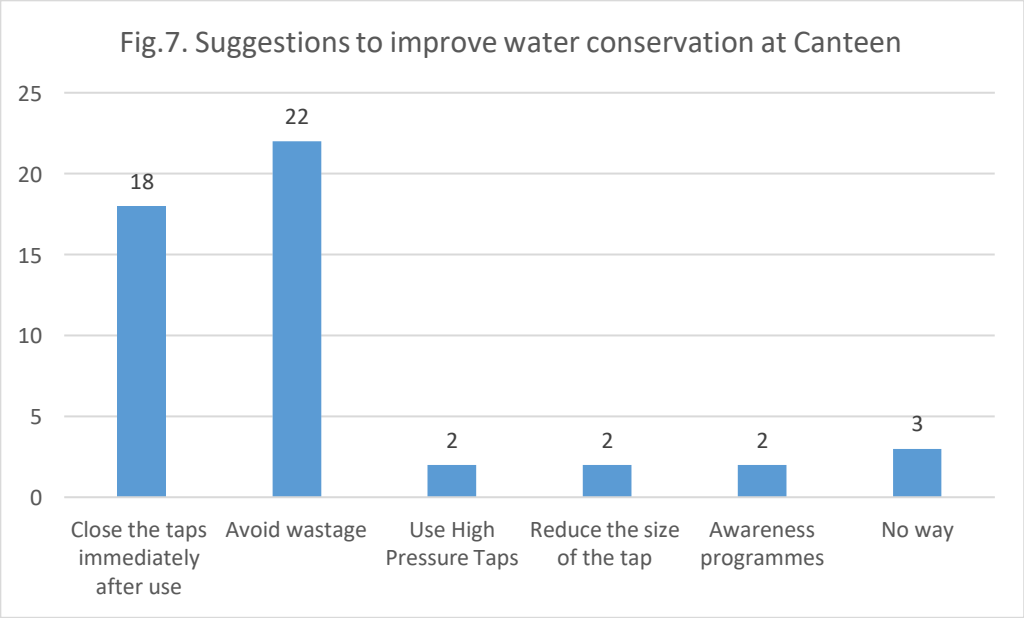
Participants have confidential knowledge about the wastage of water in the canteen but they exposed it through the survey (This also shows their positive attitude towards water conservation). 72.4% of the participants (Fig.4) revealed that there is significant wastage of water in the canteen. However 27.6% of the staff doesn't think that there is any loss of water.



Participants reported that highest share of water wastage is in plate/glass/utensils washing area and in Kitchen (86%) followed by wash area (5%) (Fig.5); this means that the measures which would be implemented with the participation of canteen staff solve the issue up to 80%.



79.3% of the participants strongly believe that certainly there are avenues to save the water in the canteen (Fig.6). This is again an evidence for the positive attitude of the community towards water conservation. This will enable the management to implement water conservation measures with the participation of the Canteen community. It is also appreciable that 80% of participants have some suggestions to improve water conservation in the canteen.



22.45% of the participants gave valid suggestions to avoid wastage of water especially in cleaning and washing. 18.37% suggested at least a method for that too; close the tap immediately after use (Fig.7). There are few other suggestions like use of high pressure pipes fort washing and cleaning, reduce the size of the tap in order to minimize wastage of water, conducting awareness programmes and continuous education programmes *etc*. However 3.6% of the staff believes that there is no way to improve water conservation.

Interactive Session

Altogether 49 staff members (out of 75 canteen staff) were participated in the session in two batches. A short training was given on water conservation and participants shared their opinion and experiences regarding water conservation measures.

ACTION PLAN

Based on the input from the participants, observation on the functioning of the canteen and input from the system authorities and staff the following action plan for Sustainable Water Usage (SWU) in the Canteen is suggested. The activities are suggested under two heads: infrastructural changes & Habitual Changes. Besides regular monitoring and awareness campaign is suggested.

Infrastructural Modifications Required

1. Change present taps in the Kitchen which are using for washing to High pressure systems- Hydraulic hose and pressure fittings are suggested (1/4" to 1" size available- best for multiple use).

Two additions shall be done: (1) A high pressure pump in the main line to the hoses (see Fig.8; approximate prize- Rs.4000/- to 10000/-). Only one pump for the entire line.

Fig.8. A high pressure pump to be fitted on the line

(2) Fit high pressure water spray gun at the end of all hoses (Fig.9) (Rs.350/- to 1000; use the type that is used in vehicle service stations- durable & long lasting).

Fig. 9. One model of High pressure water nozzle

Note: The above two devices may be selected in consultation with automobile service station people for better products.

2. Change the present taps at the glass wash area to ½" stainless steel or brass hose tap (2 Nos. Approx. price Rs.350/- to 500/_ per one).

Fig. 10. Pressure taps

3. Change the pedal operated taps in the wash area to sensor taps. So, whenever hand exposed under the tap automatically it will on. But after 30sec. (or whatever the time we set) it will get off. This will avoid wastage of water (approximate cost for heavy duty, durable product- Rs.10,000/- per one).

Fig. 11. Heavy duty Sensor taps

4. Fit water flow-meter at the main lines towards each major consumer points in order to measure daily consumption of water at the respective points (approximately Rs. 2,500- Rs. 8,000).

Fig. 12. Water flow-meter

5. Instruction/information boards at all sites: wash area, kitchen, waste collection area; kitchen, washing area etc.

6. Urgently fit an auto-float stopper system for preventing spill out in steam connection.

7. Display a board with content changing facility (better electronic board) – just show how much water every day we use in different consumption points in the canteen. LED display board or LED TV screen can be used. Informative videos also can be displayed.

Habitual Changes suggested

1. Strictly regulate the use of treated water for drinking and cooking purposes alone. The energy wastage pertaining indirectly shall be addressed.

2. Conduct a training session for respective staff and canteen users after installing new infrastructures.

3. Highest wastage of water is in washing and cleaning processes. So such staff shall be continuously informed and regularly monitor their performances.

4. Declare a monthly award for best performers – as Water Champions-for saving water at different user points based on their contributions. A gift or memento is enough. Their names should be displayed for a week in the following month, on the display board.

5. Teaser, reels or short videos of 1-2 minute duration on water conservation shall be displayed throughout in the display board.

6. Conduct a monthly meeting of all the canteen staff and review the whole activities.

7. After achieving the target, conduct a small felicitation function.

8. Regular monitoring shall be in place. Explore further areas to reduce water consumption from the targeted level as a second phase.

CONCLUSION

Sustainable water management can be achieved only through a participatory process. Hence, the involvement of all stakeholders must be ensured. If so, 100% success can be expected

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