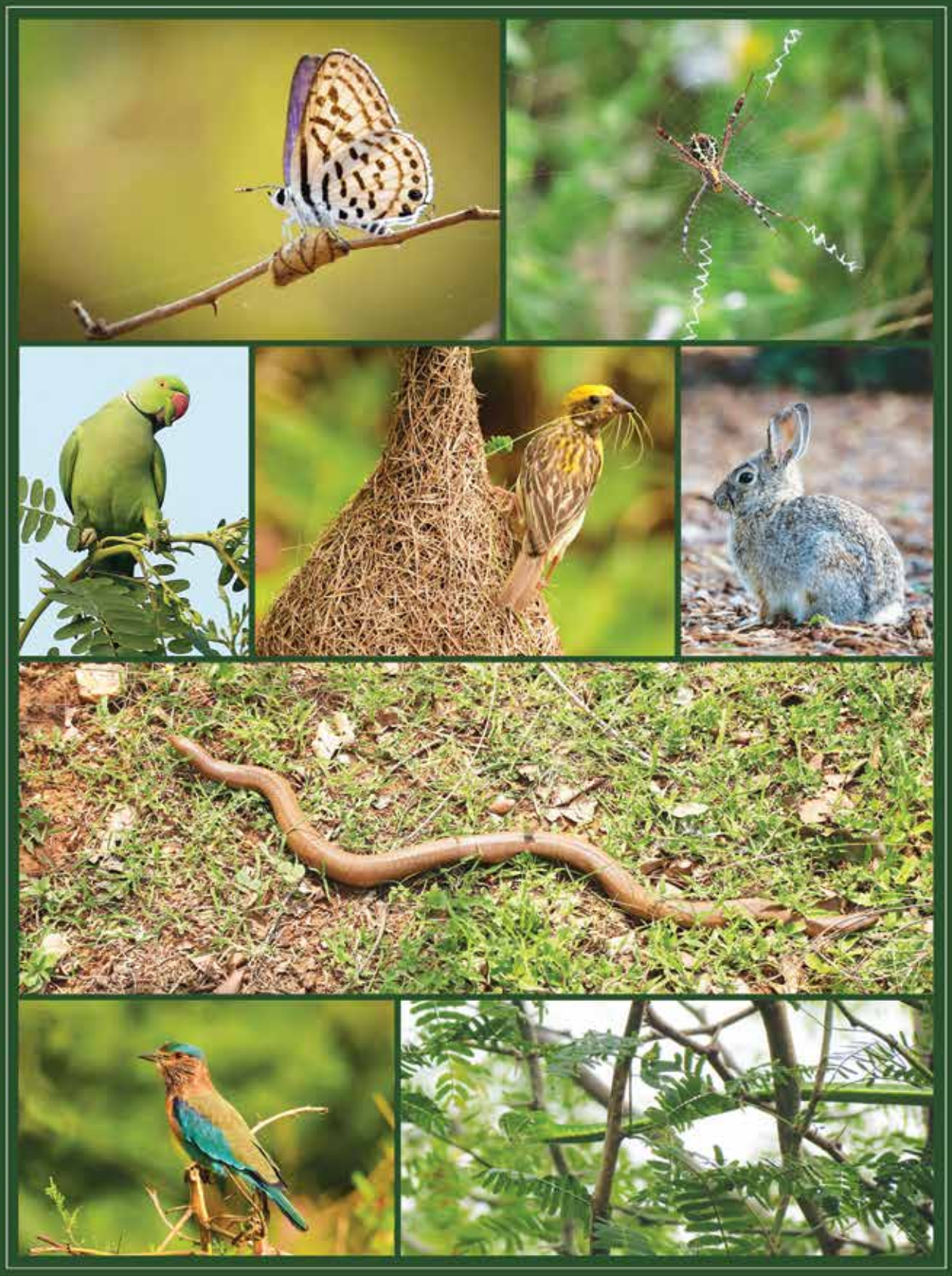
Vanathukkul Tirupur

Ecological Impact Survey Report - 27.02.2021

Prepared by

SIDDHARTH FOUNDATION
Coimbatore

In 6 years 1 Million + Trees Planted



SIDDHARTH FOUNDATION
No. 26, Abbas Garden, TVS Nagar,
Coimbatore - 641 025. Ph : 79026 51776
E-mail : info.siddarthfoundation@gmail.com
Website : www.siddharthfoundation.net

VETRY
SF No. 77, Classic Compound,
Periyandipalayam, Tirupur - 641 687. India.
Ph : 0421 - 7170000 / 90470 86666
E-Mail : info@vetry.in | Website : www.vetry.in
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Individually,
we are one seed.
Together, we are a
FOREST!
VETRI

Vanathukkul Tirupur

Ecological Impact Survey Report

Vanathukkul
TIRUPUR
A Tribute to kalam

Prepared by

Siddharth Foundation

Coimbatore

VETRY
PEOPLE, EMPOWERMENT, ENVIRONMENT, EDUCATION

Hosted by **VETRY**

AUTHORS

Dr P.Pramod, Principal Scientist, Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Dr.Rajesh Ramnarayan, Siddharth foundation.

Mr P.N Anoop Raj. Fellow & Managing Trustee, Siddharth Foundation, Coimbatore.

Dr Dhanya Praveen, Scientist, Tamil Nadu Agricultural University, Coimbatore.

Dr S.Muhil, Fellow, Siddharth Foundation, Coimbatore.

Research Team :

Mr. J. Gopalasamy. Senior Research Fellow, Annamalai University & Project Manager Siddharth foundation, Coimbatore.

Ms. Devika, Volunteer, Siddharth foundation, Coimbatore.

Mr. Harikumar, Volunteer, Siddharth foundation, Coimbatore.

Ms. Sri Soumya, Project Fellow, Siddharth foundation, Coimbatore.

Mr. Velu Kumar, Project Assistant, Siddharth foundation, Coimbatore.

Mr. Jeevith. S, Junior Research Biologist Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Mr. Prakash. L, Junior Research Biologist Salim Ali Centre for Ornithology and Natural History, Coimbatore.

ACKNOWLEDGMENT

First, we thank VETRY for allowing us to study the ecological impact of the Vanathukkul Tirupur Project. We wish to express our sincere gratitude to the person behind the idea of this study Mr T.R.Sivaram (M/s Classic Polo), President of VETRY, for continuous support and motivation. This study got initiated only because of his interest and enthusiasm to know the real impact of the Vanathukkul Tirupur project. He offered us all the help to complete the study. We wish to thank all leaders of VETRY, especially Mr D.M.Kumar, for his continued inspiration and support to our works. Many from VETRY were very helpful to us in our hard fieldwork, such as Mr Sathuragiri, for his patient support for our field survey and Mr Hariprakash for all logistic support.

Our sincere thanks to fellow researchers and volunteers, who have been actively involved in all field survey. We wish to put on record thanks to our research team lead by Mr Anoop Raj and Mr Gopalasamy, Dr Rajesh Ramnarayan, and Mr Harikumar Mr Jeevith, Mr Prakash, Ms Devika, Mr Velukumar and Ms Sri Sowmiya for their hard work in the field. Thanks, Dr Chitra, Dr K.R. Manikandan, Mr Dilip Sundar, and Mr Rajkumar from Tamil Nadu Agricultural University to support Insects identification. Thanks to Dr Suhirtha Muhil for her inputs to the draft of the report. We thank the Indian Council of Agricultural Research staff - Krishi Vigyan Kendra, Nagapattinam, for helping us in soil analysis. We thank Mr Terrin Jomics and Mr Jerof-in Derill for the photo and video documentation of the programme.

We wish to express our gratitude to Dr P.A. Azees, an expert scientist in environmental impact assessment and former Director of Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Finally, we would like to thank all the good hearts of Vanathukkul Tirupur landowners who have shown their willingness and concern for nature conservation. We thank all well-wishers for their continuous support, encouragement, and prayers for successful completion of project.

- Authors.

SHAMBHU KALLOLIKAR, IAS.,
Principal Secretary to Government

Environment and
Forests Department
Fort. St. George, Secretariat, Chennai - 9.
Tele : 044-2567 1511
Fax : 044-2567 0040

Dated .....

FOREWORD

காடுகள் செய்வோம்

நல்ல நாடுகள் செய்வோம்

காக்கை குருவி எங்கள் ஜாதி

காடும் மலையும் ஏழைகள் வீடு

Thus wrote the Great revolutionary Tamil Poet Bharatiyar **"By creating Good Forests, let us create Good Country", "Birds are our creed, Forests and Mountains are our house"**.

I am happy that the Voluntary Organization for People Empowerment of Rural Areas by Youth (VETRY) is working for the protection, conservation of forest and biodiversity of the region. The industrial development must go hand in hand to maintain environmental equilibrium. If this equilibrium disturbed, immense damage will happen to mankind, in the form of drought, flood, rise in temperature etc.

The team has been developing social forestry through Mass Tree Plantation project at free of cost in the barren land of private farmers for the past 5 years in Tiruppur District. It is highly appreciable that the team has planted about 8 lakh trees covering 48 species and helping to grow as many as 241 species, through birds dropping and Carbon sequestration to the tune of 140 tons. I would like to congratulate all the VETRY team members for the efforts taken and request them to continue this project in other districts also.

The efforts taken by VETRY to bring out a entire study document in a form of a book titled "Vanathukkul Tirupur" (An Ecological Assessment) is welcome effort. I further place my heartfelt wishes to the authors of this book, who have taken pains to collect all the information and put it in book form for future reference.

SHAMBHU KALLOLIKAR

TAMIL NADU FOREST DEPARTMENT

THIRU I. ANWARDEEN I.F.S.
Additional Principal Chief Conservator
of Forests & Director

TAMIL NADU FOREST ACADEMY
COIMBATORE - 641002.
Phone : 0422 - 2432642
Email - ccftnfa@tn.nic.in/
apccftnfa@gmail.com

Date:

Sir / Madam,

Our constitution imposes a duty on every citizen "to protect and improve the natural environment including forests, lakes, rivers and wildlife". By implementing the greening project, "Vanathukkul Tirupur", VETRY had manifested the environment leadership in citizen greening to improve the environment. As an environmental leader VETRY involved the common man of the society to join and participate in the greening movement to protect and enhance and ameliorate the natural environment including the native flora and fauna so that the society of Tirupur benefits from a wide range of ecosystem services from citizen forests of 1598 acres of land.

It is said that a tree grown outside forest is a tree protected inside forest. Trees outside the forest (TOF) are increasingly recognized by policy-makers, planners and managers as an essential component of sustainable development. Environmental benefits of TOF can be indirectly assessed by measurable indicators, such as the number and type of trees, birds, with other environmental variables such as soil fertility improvement. In an urban setting, tree cover has direct impact on the ambient temperature. The ecological functions of TOF are equally decisive in ensuring the biodiversity, ecosystem functions and the habitat heterogeneity so that integrity of key ecosystem processes of different habitats remain intact and continue to flow sustainably. I commend VETRY for this first of its kind efforts to study, map and profile the environmental incentives that arise from a new afforestation and greening programme using a well laid out scientific sampling and analysis plan. It is heartening and inspiring to see that the study has revealed that there is tremendous species diversity and recovery of native environmental quality in the afforested area with documentation of 241 species of flowering plants, of these 72 species were trees (in which only 48 was planted), 79 species of birds and 65 species of butterfly. It is an indication that the project has created heterogeneous habitats

through the afforestation work led to the abundance of floral and faunal diversity and thus indicating greening initiatives and restoration and augmentation of native biodiversity of a locality go hand in hand.

Scientists suggest planting billions of trees across the world is one of the biggest and cheapest ways of taking CO_2 out of the atmosphere. Trees are usually 50 percent carbon by weight, which comes from carbon dioxide absorbed from the air. Intergovernmental Panel on Climate Change in 2018 suggested that 950 million hectares of new forests could help limit the increase in global average temperature to 1.5 degrees Celsius above pre-industrial levels by 2050. Planting of trees helps combating climate change. It is heartening to note that VETRY had planted eight lakh trees and the project "Vanathukkul Tirupur" had already sequestered more than 140 tonne of Carbon providing clean and green air.

The green infrastructure created by the project "Vanathukkul Tirupur" promotes the physical and mental wellbeing of the Tirupur residents. Urban green spaces constitute a necessary feature of healthy settlements. It is heartening to see the citizen forests created by VETRY will provide to create opportunities for exposure to nature, reduce air pollution and noise, climate moderation, aesthetics, stress reduction, life satisfaction, healthy living and improving the living ambiance.

Indian Forest policy 1988 envisaged a minimum of one-third of the total land area of the country under forest or tree cover. As part of its commitment to reduce carbon emissions and to meet pledges made under the Paris climate accord our country is aiming to increase the forest area and green cover to one third of its total land area by 2030. The scientific assessment made by VETRY is evident that project "Vanathukkul Tirupur" has proved that voluntary citizen action has got a tremendous role in achieving the policy targets of tree cover and improves the ecological security of our country. Citizen's participation is the key to environment protection. I commend VETRY for having set a first successful model in the country for citizen participatory afforestation in public and private lands.

I congratulate VETRY and the study team for this very plausible effort by examining the impact of their greening project on various environment and biodiversity indices which is again the first of its kind in the state. I wish VETRY more and more success in creating voluntary citizen forests.

(I. ANWARDEEN)
APCCF & Director
Tamil Nadu Forest Academy
Coimbatore - 641 002.

Dr. K. Vijayakarthikeyan, I.A.S.,
District Collector.
Tiruppur.

Collectorate,
Master Plan Complex,
Palladam Road,
Tiruppur - 641 604.
Phone : 0421 - 2971100 (O)
0421 - 2488811 (R)
Fax : 0421 - 2971111 (O)
0421 - 2488822 (R)

Dated: .08.2020.

Environment and Industry are often perceived to be divergent goals that are even thought to cancel each other out. The Conservation vs Development debate has been with us forever and the grail for mankind today is a synergistic model that can tap into the virtues of both. Evolving such a model in realtime requires phenomenal effort, resources and coordination. One such model set in Tiruppur, the industrial hub of Tamilnadu, is the "Vanathukkul Tiruppur" initiative which has just crossed the 5 year milestone. Since inception, this model has been steadily evolving, successfully fulfilling all the environmental deliverables it had promised when it was flagged off by the great Dr Abdul Kalam.

During these years, 8.5 lakh native trees have been planted, watered and maintained by the Vanathukkul Tiruppur team and by the end of 2020, a million trees would have been planted across the district of Tiruppur. A million trees in the midst of a 3 million population. That means that there will be one tree for every third person living in Tiruppur. These trees also provide habitats for an expansive array of flora and fauna, creating a thriving ecosystem. About 140 tonnes of carbon sequestered as per data projections as a result of this project, is another of the multiple tangible outcomes of this initiative.

Viability and Sustainability are the two important parameters which can make or break any project; and Vanathukkul Tiruppur has achieved these by large scale community involvement and empowerment. Over the years it has emerged as a solid platform bringing in to its fold industrialists, NGOs, volunteers, Government officials, media and common man, and instilling a sense of ownership to each of them.

In the modern world, cities are often defined by the major periodic events/ initiatives in their calendar year - art / film festivals, sporting events, book fairs, etc. The biggest such event of a city often shows the character of the place, and, going by that, Vanathukkul Tiruppur is a testimony to the enterprise, hardwork and conservationist ethos of the people of Tiruppur.

Congratulations on the Environment Impact Study done on this highly rewarding project and my best wishes to the entire team to take the project forward and make it an international model in the coming days.

District Collector,
Tiruppur.

K.P.R. MILL LIMITED

Corporate Office : 1st Floor Srivari Shrimat, 1045, Avinashi Road, Coimbatore - 641018. India ✆ : 0422-2207777 Fax : 0422-2207778

31.08.20

Shri T. R. Sivaram,
Founder of VETRY,
S.F.No. 77, Classic Compound,
Periyandiapalayam, Tirupur – 641687.

Foreword Message

I am delighted to write the foreword for "Vanathukul Tirupur", an ecological assessment of the Herculean Task of transforming the Industrial City 'Tirupur', clouded by ecological concern, towards Greening movement. Mr. T. R. Sivaram, a best friend of mine, well known for his successful entrepreneurship and a staunch follower of Dr. Abdul Kalam, mooted this noble cause. It is implemented by a Novel team consisting of like- minded Dignitaries and Philanthropists with the support of Industrialists and Volunteers.

VETRY, originated as a Green Park Trust in 2001 with the mission of creating environmental awareness to save the mother earth and our future, has planted and monitors significant trees at Tirupur. VETRI is now marching with a pride towards the goal of planting one million trees, an amazing task. Happy to note the movement's potential of bringing together the largest community of Tirupur under one umbrella for the co-ordinated action towards nature conservation and sustainable development.

The unique ecological assessment made by an eminent team of Professionals in threadbare, reveals the extensive and sincere efforts initiated by Mr. Sivaram and his dedicated Team. Their intensive study elaborates the strategic selection of trees, its immense benefits such as bio-diversity augmentation, soil transformation, livelihood sustainability, return of nature & living ambiance. It has indeed proved the movement a socially meaningful, economically pragmatic and environmentally sensible effort.

I hope that this book will provide an effective learning experience and referenced resource for the Young Generation, who are the Future India. I wish the' greening Endeavour' a massive success in returning of nature to Tirupur City.

Regards

P. Nataraj
Managing Director

Regd. Office : No. 9, Gokul Buildings, A.K.S. Nagar, Thadagam Road, Coimbatore - 641 001. ✆ : 0422-2478090, Fax : 0422-2478050
GSTIN : 33AACCK0893N1Z9 Email : corporate@kprmill.com Web : www.kprmilllimited.com CIN : L17111TZ2003PLC010518

Voluntary Organization For People Empowerment of Rural Areas By Youth
S.F.No. 77, Classic Compound, Periyandiaplayam, Tirupur - 641687, INDIA.
Ph : 0421 - 7170000 E-mail : info@vetry.in
Regn. No. 1211/04 / PAN No. : AABTA5604M / TAN No. : CMBA05333G

ACKNOWLEDGEMENT :

Am thankful for the Team @ Siddarth Foundation – to do a Six months field Survey @ VT Fields – and bring out this audited results .

Although VETRY has been in the job of Ecology conservation for past 20 years - our scale of operations has been increasing year after year – and today we are proud to declare a Million Tree completion @ Tirupur – and that too - with 88 % Survival rates – is a History by itself .

All this started as a homage to Dr.APJ –and a humble target of One Lakh was the goal – Years passed by and in Six years of Persistent efforts of Team VETRY – and all other NGO's of our District – this has become a people movement in Six years, crossing million trees.

Today Business people are buying Barren lands in our District – just for Tree Plantation – and this is purely because of the awareness created by VT in past 6 years – which is a positive sign of bringing back the depleted nature .

More important note is – Farmers who left farming because of water & worker scarcity –are now back in Tree farming –and this has least man power needs – and we offer Species those are best suitable for Soil & water quality present in the site .Thus we have improved the revenue stream of many poor farmers of our District – while pure air and increased rainfall belongs to the society as our mantra .

Leading Tamil Vernacular Dinamalar – has offered us the Media Partner status – and their unconditional support led us this awareness among public – which made the project success. Our sincere thanks for entire team @ Dinamalar .

My appreciations to all our Volunteers who have been working 24x7 to make this project successful one – and special thanks to all staffs of Classic Polo – who rendered loads of Men , Material , Money and all other resources to this VT project free of cost .

My heartfelt gratitude to all my family members for their whole hearted support – in particular my elder brother & Chairman of Royal Classic Group – Mr.Gopalakrishnan – without which this project would not have happened .

With warmest regards,

For VETRY,

Sivaram.T.R.
Founder / President .

PREFACE

Tirupur, the industrial city of Tamil Nadu in India is a hub of production and export of knitwear. Rapid industrialization has led to a high level of environmental pollution and depletion of biodiversity of the area over some time. In response to this, a team of people under the NGO "VETRY" banner came forward to mitigate it to the extent possible. The best option they felt was to go for a mass afforestation programme in the area. VETRY identified environmental degradation as one of the pivotal problems Tirupur has to deal with on an urgent basis. Taking motivation from the great scientist and former President of India late Dr APJ Abdul Kalam, they initiated a mass afforestation programme in 2015. They planted eight lakhs trees in five years. This was one of the unique participatory afforestation programmes in which industrialists, farmers, nature lovers, and administrators participated with full enthusiasm. Just before their ambitious attempt to reach one million trees in the sixth year, leaders of VETRY decided to go for an independent assessment of the success of the programme and entrusted Siddharth Foundation, Coimbatore, an organization of research and action in environment and education, to do this work. This is a short, rapid assessment of the on-going afforestation programme's status and the level of its success. This being a short-term project conducted for six months, the seasonal changes of the entire project area's biodiversity and study were not covered. However, we have presented a genuine and sincere assessment of an important and most relevant programme.

- Authors.

EXECUTIVE SUMMARY

VETRY has entrusted Siddharth Foundation a rapid assessment of the Vanathukkul Tirupur programme with the stated objective of independent evaluation of the status of the programme and its contribution towards greening and improving the environment. VETRY has planted one million trees in six years in 481 plots. Of these, the research team surveyed plantations, enumerated the species, and evaluated the plantation's success. A sample of 70 plantations was then selected for intensive surveys in search of the collateral benefits of the programme. Vegetation, birds, butterfly, and spiders were studied in detail with standard scientific procedures. Opportunistic sampling was done to understand the general insects, odonates, reptiles, and mammals supported by the afforested lands. Assessment of the biomass as a preliminary estimation of its contribution to carbon sequestration was also attempted. A comparative analysis of soil parameters in different plantations was also done.

Out of one million trees planted, 87 percent was directly planted by VETRY in its members' designated lands, well-wishers, nature lovers, and farmers. The remaining ones were planted in various public locations such as roadsides and public lands which are difficult to trace back to monitor their success. So the research team has restricted assessment only to this 87 per cent of the trees planted by VETRY across the Tirupur district. Our assessment revealed that 88 per cent (7,65,000 trees) of these trees are growing well in the plantations wherever they were planted. This survival rate is excellent compared to other similar afforestation programmes elsewhere.

Ten lakh trees, belonging to 50 species, planted include a mix of trees for a direct benefit (such as timber trees, fruit trees, medicinal trees, and for general biomass production) and environmental benefits (such as natural forest trees). Over six years, thus created vegetation has made a significant natural infrastructure in the land and has brought back significant biodiversity to the locations. The study recorded 263 species of flowering plants that include 169 herbs, shrubs, and climbers from the selected sample plantations. 79 species of birds, 65 species of butterflies, and 41 species of spiders recorded only from the sample plantations are exceptional for an arid biotope of Tirupur in a short survey during the summer months.

This short-term study is giving only an indication that Nature is recouping in Tirupur through the Vanathukkul Tirupur programme. This one season survey cannot give a complete picture or

the magnitude of that positive change, and all-season survey is required for that. However, this rapid survey gives enough evidence that the Vanathukkul Tirupur programme is progressing in the right direction. The survey also provides good evidence for the excellent return of biodiversity within the short span. The plantation may take a few more years to develop into mature ecosystems with high biodiversity and food webs.

The programme has been of benefit from several dimensions of which the major ones are two. One is the environmental benefit that the programme is creating. The other is a direct commercial benefit to the farmers and planters participating in the program in the coming years. The environmental benefits include improving soil quality, biodiversity augmentation, carbon sequestration, and oxygen replenishment/air quality.

Soil parameters examined to show that the soil is improving in total organic content and many other parameters towards better fertility from a very nutrient depleted condition.

The programme has sequestrated more than 7000 Metric tons of carbon dioxide from Tirupur air and locked in the accumulated biomass within this short period. Its role in ecosystem services such as in oxygen replenishment, air pollution reduction, water pollution, groundwater replenishment, and noise reduction need further detailed studies.

The study has identified the best practices and species that could grow fast and better. Considering the result of this study area and in consultation with experts in the field, the report also presents recommendations choice of tree species for planting in future Vanathukkul Tirupur programmes

Plantation by District Collector Dr. K.S. PALANISAMY on 31-5 - 2018 along with key members of VETRY

VANATHUKKUL TIRUPUR – AN INTRODUCTION

Tirupur, the T-Shirts city of the country, is a major centre of production and export of garment materials and knitwear. The fast growth of industrialisation in the area, while economically rewarding, has resulted in some unintentional and necessary evil as a by-product - pollution and fast depletion of biodiversity in the area. Many people with greenery in the heart started feeling the deprival of this greenery in their surroundings as one of their major limitations and felt something should be done for it. Such thoughts probably would have been the prime motivation behind the creation of "Karuvampalayam Green Park Trust" in 2001 which later was renamed as "Andipalayam Green Park Promotion Trust" with the mission of creating environmental awareness and planting trees around Tirupur city. Later it was again renamed into its present avatar VETRY (Voluntary Organization for people Empowerment of Rural areas by Youth), a social organisation. VETRY was constituted by industrialists and socially conscious people of Tirupur. They organised several programmes like the rejuvenation of Andipalayam Lake, construction of Green filed Government Higher Secondary School building at Iduvampalayam, and renovation of Veera Raghava Perumal Temple in Tirupur.

In this background, many felt the need for a greening movement in Tirupur. This thought process was ignited further by the call of former people President of India Dr. APJ Abdul Kalam to plant trees to save the earth and our future. Mr. T.R.Sivaram (M/s Classic Polo) narrated Vanathukkul Tirupur's genesis (VT) as a movement of Tirupur people initiated and organised by VETRY. The sudden demise of Dr. Kalam put many of his followers under tremendous agony, which they have decided to translate into constructive actions. VETRY organised a procession in the Tirupur city to pay the final tribute for Dr Kalam and also took a pledge to plant and maintain one lakhs tree saplings in Tirupur City. VETRY started the Vanathukkul Tirupur programme in August 2015, on the 26th day from the demise of Dr. Kalam. They planted 135000 saplings within 120 days with the support of industrialists, 35 civil society organisations and volunteers. VETRY planted saplings in private and public places such as roadsides, school & college campuses, temple-lands, and around Government offices.

They took care of the planted trees seriously, watered them with tankers, and monitored periodically. Many farmers and private landowners voluntarily came forward to make it a real participatory programme. Many philanthropists and organisations volunteered their support and participated in the programme. Initially, saplings were taken from many organisations and the Forest Department. Later they (VETRY) have developed a nursery of their own.

VETRY purchased 30 tractors through CSR support from many well-wishers to water the

saplings and fixed GPS device in the tractors to monitor the periodical watering. "VT – Phase 2" planted 2.25 lakhs tree saplings in 2016, then 1.55 lakhs saplings in "VT – Phase 3", 1.5 lakhs saplings in "VT – Phase 4" , 1.35 lakhs saplings in "VT – Phase 5" an 2.53 lakh saplings in VT 6 respectively. Thus, since 2015, VETRY had planted more than one million tree saplings in the region.

The name Vanathukkul Tirupur came with a dream of making the almost desert-like Tirupur to a forest-like environment. On a friendly visit to some of these plantations by members of the Siddharth Foundation (a Coimbatore-based organisation working in education and environmental fields) felt the magic of return of wild biodiversity happening in VT plantations. They realised that this magic needs to be documented because this has a high potential to motivate others and energise people attempting urban afforestation across the world. That thought prompted this study “Vanathukkul Tirupur– An ecological Impact assessment”..

30 Tractors Sponsored by Tirupur Corporates for Watering the plantation

TIRUPUR - THE LAND AND THE BACKGROUND

Tirupur the land of textiles

Tirupur is located at 55 Km east of Coimbatore in Tamil Nadu. The name Tirupur literally means ‘the place of turning back’. Tirupur was born and evolved on the fertile banks of Kanchi nadhi (present Noyyal River). Tirupur, a part of the erstwhile Kongu Nadu region ruled by the Cheras Dynasty, was part of a prominent Roman trade route that connected India's east and west coasts. During the medieval period (10th century CE) Cholas conquered the Kongu Nadu and this place became part of the Chola Kingdom. Then the region came under the Vijayanagara Empire's rule by the 15th century and later Palayakkarars, the chieftains of Madurai Nayaks ruled the region.

Later in 18th century, the region came under the Kingdom of Mysore, following a series of wars with the Madurai Nayak Dynasty. After Tipu Sultan's defeat in the Anglo-Mysore Wars, the British East India Company annexed the region into the Madras Presidency in 1799.

Tirupur has been the centre of the textile business since 1870 (Cawthorne, 1995). Today, it is the major garment cluster in India, employing more than six lakhs people directly and indirectly. There are 7,250 units involved in various operations of the textile industry here (TEA, 2011). Almost every household in Tirupur town undertakes some activity related to the knitwear industry in the residence-cum-factory setting.

Two major rivers pass through Tirupur district - river Noyyal and river Amaravati. Of these, the river Noyyal one of the tributaries of the Cauvery river flows through Tirupur city. Several industrial units such as textile units, chemicals, and electroplating are located on the river basins which discharge their untreated and partially treated effluents into this river. Besides, sewage from Coimbatore and Tirupur cities is also being released into the river without much treatment, making the Noyyal highly polluted. The Noyyal is a seasonal river with good flow only for short periods during the North-East and South-West monsoons. Occasionally flash floods occur when there is heavy rain in the catchment areas. On 1992, Orathuppallam dam was constructed for the farmers of the region to promote agriculture. However, after five years, this dam has become a storage tank for textile effluents, further reducing Tirupur Karur district's agricultural activity.

Amaravathi river originates from Manjampatti Valley between the Anaimalai Hills and the

Palani Hills in Indira Gandhi Wildlife Sanctuary and National Park of Tirupur district. It flows through Dharapuram and Aravakurichi and joins with River Cauvery in Karur District. Amarvathi Dam in Udumalpett was built primarily for irrigation and flood control. This river irrigates the agricultural lands of Tirupur and Karur districts.

Figure 1. Map of Tirupur District

Ecological Problems

Till the early 70s, Tirupur was a Village in Palladam Taluk in Coimbatore District. Due to the excellent quality cotton produced here and many spinning mills functioning in the Coimbatore region, Tirupur emerged as a Knitwear Hub. From 1970 till 1980, only Bleaching units were available in this region, letting down their process effluent into the nearby river Noyyal.

Post-1980s, the export of garments started slowly from Tirupur, which brought up the need for dyeing factories here. And since there was not much environmental awareness among the people there, factories were allowed to discharge raw effluent into the Noyyal river, which ruined the entire farming community downstream in Erode and Karur districts. Those farmers lost all their livelihood between 1995-2010, as by then the industry in Tirupur was on a rampant growth with the decline in other knitwear / hosiery centres such as Ludhiana. That resulted in a

huge migrant population. The bleaching, dyeing, and knitting industry's growth resulted in a huge volume of industrial effluent water and domestic sewage mixed with other municipal and commercial effluents. All the spoil sporting came to an end, in 2011 when the Government of Tamil Nadu - Pollution Control Board (TNPCB) has got direction from Hon. High Court of Madras to close down all 734 dyeing / bleaching factories functioning in this region. That brought a radical change in the industries, and by 2012 all factories have complied with Zero Liquid Discharge (ZLD), the first of its kind in the world. Today Tirupur processing industries recycle 100 % of their effluent water, almost 15 Crore litres / day, and thus completely stopping industrial effluent release and consequently arresting polluting Noyyal river. However, sewage from the city is still let out in the river. Now under the Smart City scheme, it is being planned that via under-ground drainage system, by end of 2022, Tirupur Municipal Corporation would recycle 100 % of its sewage.

The damages created by Industry for the last couple of decades are fading away slowly. There was the complete evacuation of the Orathupalayam reservoir that had accumulated effluents and desilting of the river course under the direction of a high-court appointed committee. Further in 2019 and 2020 south-west monsoon had brought flash floods in the Noyyal river. After the flash floods, entire water has been stored in the Orathupalayam reservoir and Chinna Muthur barrage for Karur and Erode district farmers' irrigation. Thus after a long legal battle of the farming community of two decades, relief is slowly setting in. However, the damage done to groundwater quality and soil will take a few more years to come back to its original state and that could be hastened by proactive steps such as greening the environment and recharging aquifers. As the areas get only low rainfall (Annual average - 617 mm) the local rainfall on its own would have only a marginal effect in reducing the pollutants impact unless other simultaneous proactive steps are taken.

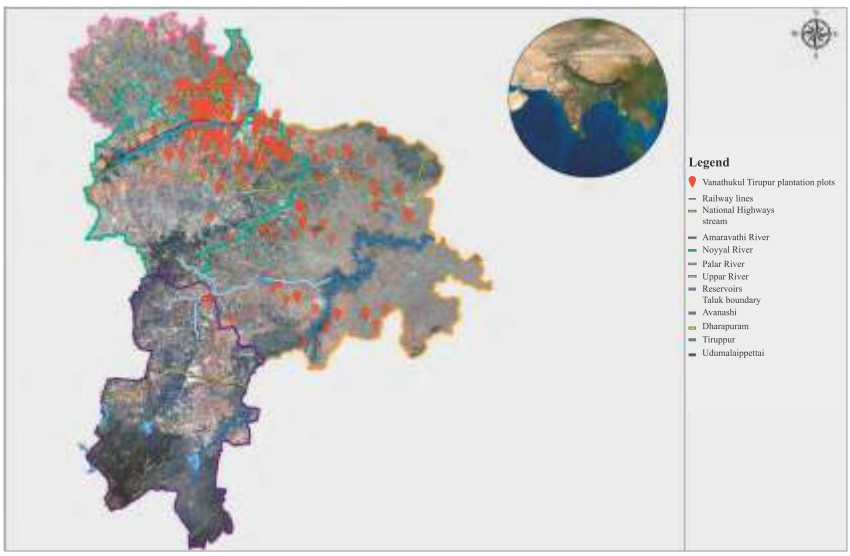
VANATHUKKUL TIRUPUR – VISION & THE PROJECT

In the context of high industrialization and high pollution levels, the best of the measures to mitigate and rejuvenate nature is identified as planting trees. Trees' ability to absorb carbon dioxide and release oxygen, recharge the water table, reduce pollution (noise, air and water), and control ambient temperature prompted members of VETRY to consider that as a nature-based solution. That is the time the clarion call of a visionary came to them. Dr. APJ Abdul Kalam's motivation to plant more trees as the best way to deal with most of our environmental problems gave the team their vision and added momentum.

VETRY named the programme as "Vanathukkul Tirupur", instead of just tree plantations due to this vision. They have realized that the 'Vanam', that is forest, is more than a plantation. They wanted to bring the bits and pieces of the forest to their proximity, physically and mentally.

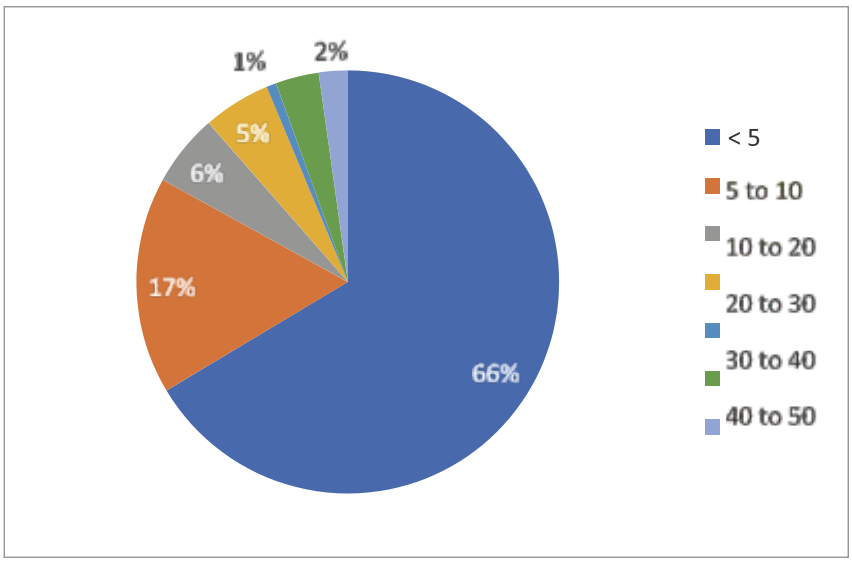
The barren soil of Tirupur was eagerly waiting for some shade to come, cover and control the water from getting evaporated. Desperate birds of Tirupur wanted some branches to perch, lots of Urban Species around the city wanted a home to hide and live, and escape from the wrath of human activities. These local pieces of 'Vanam' created by the VT programme provided all that. These places are emerging as places of ecological functions and inter-relations among diverse organisms in nature. This piece of recreated 'Vanam' contributes more to the wellbeing of all humans and all life forms in the region and provides a range of Priceless tangible and intangible ecosystem services. As it grows, trees transform the microhabitats and micro-climate of the place and infuse life in its surroundings.

Figure. 2 Vanathukkul Tirupur plantations.



The "Vanathukkul Tirupur" project locations were distributed across the Tirupur district. A few plantations were outside the district as well. The project covers 2071.2 acres of land, distributed across 481 plantation sites. Out of this, 70% of plantations were polyculture (with many different species of trees) and the remaining 30% were monoculture plantations.

Figure 3. Distribution of area in plots in VT plantation (Legend in Acres)



A great majority of the planted areas (66%) are in small plantations that are less than 5 acres, making it highly people's participatory movement. The size distribution of landholdings under plantation is given in figure 3.

Salient features of the Vanathukkul Tirupur programme

- Diverse size of landholdings among plantations.
- Diverse group of people volunteering, students, teachers, farmers to celebrities.
- High volunteer participation in planting programmes.
- Strict and regular watering to the plants especially in summer months.
- Fencing and protection done by Farmers.
- Regular monitoring.
- Systematic documentation.
- Use of the plantation sites for nature education activities of school children.
- Scientific monitoring of the process.

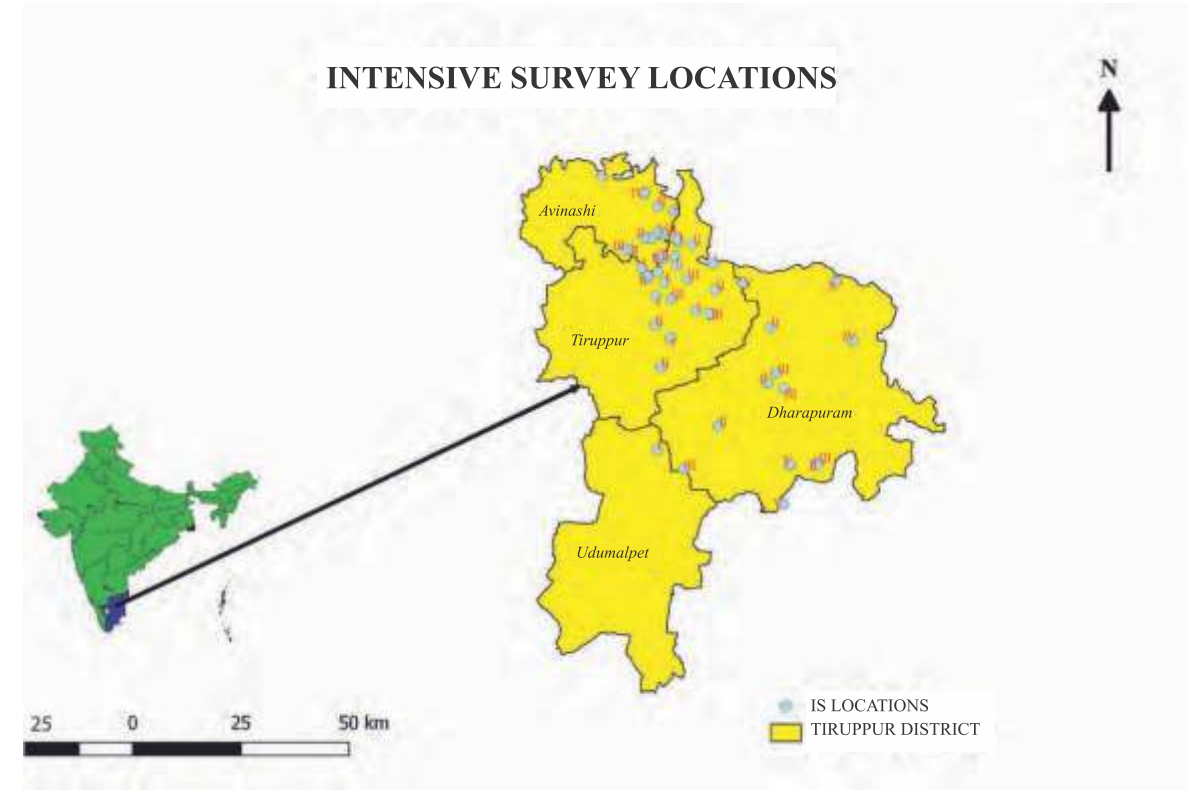
METHODOLOGY

This study was a short and rapid assessment of the status and impact of the Vanathukkul Tirupur programme. First, there was a general survey of all the plantation areas to find out the status of plantation and its survival rates, then intensive biodiversity and environmental survey to examine the impact of the programme. As it is a short duration single-season survey, all the seasonal plants and animals could not be included here in this report.

General survey and survival rate enumeration:

The team visited all the plantations and studied the planted trees using a stratified random sampling technique (Sutherland, 2000) on the survival of the different species planted there. During the surveys all associated parameters such as date of plantations, area, and the number of trees of each species planted, the number of them surviving, watering source and method, nearness to the road, water body, and other natural trees present were recorded.

Figure 4. Distribution of intensive survey locations.



Intensive study

Selection of sampling plantations: Plantations for sampling were also selected based on a stratified random sampling method. The objective of the intensive study was to qualitatively evaluate the collateral benefit of the plantations. The emphasis was given to older plantations than relatively newer ones. The new plantations and nearby fallow lands are also studied and taken as a control for comparison. Data and the analysis are based on a one-time survey of the plots.

Vegetation: Plant communities in the sampling plantations were studied using the quadrate method with 10m x 10m quadrates for trees and shrubs and multiple 1m x 1m quadrates for herbs and grasses (Cox, 1990; Mathew, 1983). In total 171 quadrates were laid in 70 plantations for the vegetation study.

Birds: Birds were enumerated using point counts of fifteen minutes duration (Hutto et al., 1986). Birds were surveyed in all the intensive study plantations (Ali et al., 1996; Grimmet et.al., 2011).

Butterflies: Butterflies were observed using a time-constrained visual encounter survey in the selected locations (Harms et al. 2014; Issac, 2016). One hour observations were made in every plantation for butterfly sampling.

Spiders: The spiders were collected by line transect sampling method, sweep netting, and direct search method. The specimens were preserved in 70% alcohol. The adult specimens were identified up to family, genus, and species level. The identification of spiders was done based on morphometric characters of various body parts using World Spider Catalogue 2020.

General insects: General insect community was sampled using a sweep net during the day and light trap method during night hours in three representative plantations for developing baseline information of the insect community in the growing vegetation.

Analysis: Basic analysis of the data was done using simple statistics and standard diversity parameters. Carbon sequestration was calculated following methods suggested by FAO (http://www.fao.org/3/w4095e/w4095e06.htm).

VANATHUKKUL TIRUPUR - AN OVERVIEW

VT STAGE	VT1	VT2	VT3	VT4	VT5	VT6	Total
Total number of plantations	43	69	50	62	47	210	481
Total area (acres)	324.97	376.46	284.25	295.32	308.2	482	2071.2
Total plants distributed	135000	225000	155000	150000	135000	253891	1053891
No trees assessed	110025	197570	139382	92480	96762	253889	890108
No of trees survived	89281	167985	119510	74132	84420	253889	789217
Survival rate	81.15	85.03	85.74	80.16	87.24	100	88.4
Plots sampled for intensive study	16	25	15	7	7	-	70
Tree species richness	26	37	27	22	22	48	72
Average GBH (cm)	29	26	20	13	12	-	N A
Average height (m)	5	4	4	3	2	-	N A
Most successful tree species	Melia dubia	Teak	Melia dubia	Melia dubia	Melia dubia	-	Melia dubia
Dominant trees planted	Neem, Jamun	Neem, Melia	Neem Melia	Neem, Jamun	Neem, Jamun	-	Neem
Herbs and shrubs - species richness	91	135	50	51	23	-	169
Bird species richness	45	65	39	39	30	-	79
Butterfly species richness	44	45	47	21	13	-	65
Spider species richness	26	54	25	2*	10*	-	41
Total carbon accumulated (tones)	788	790	330	130	*	-	2038
Carbon dioxide sequestrated (tones)	2852.56	2859.8	1194.6	470.6	*	-	7377.56

Note: *Due to technical reasons systematic sampling on spiders cannot be done in these plantations

TREES THAT WERE PLANTED

In six years, the Vanathukkul Tirupur programme has planted one million trees belonging to 70 species in 481 plantations across the Tirupur district. Table 1 gives the list of tree species and the number of live trees assessed during the present survey by the research team. The most common trees that were planted are Neem *(Azadirachta indica),* Malabar neem *(Melia dubia),* and Jamun *(Syzygium cumini).* However, the majority of the species are non- timber forest trees that are ecologically significant and environmentally beneficial.

Table No 1. List of trees and the number of live trees assessed in the study

Sl No	Scientific Name	VT1	VT2	VT3	VT4	VT5	VT6	**Total**
1	*Acacia auriculiformis*	*	*	*	*	*	988	**988**
2	*Acacia leucophloea*	*	*	*	*	*	520	**520**
3	*Adina cordifolia*	*	*	700	752	900	4287	**6639**
4	*Aegle marmelos*	*	*	500	*	*	*	**500**
5	*Ailanthus excelsa*	2000	5000	*	2500	2700	*	**12200**
6	*Ailanthus trisphysa*	100	2000	*	*	850	*	**2950**
7	*Albizia lebbeck*	23	*	4500	1500	2400	2280	**10703**
8	*Anacardium occidentale*	*	*	*	*	*	12	**12**
9	*Annona squmosa*	*	*	*	*	*	158	**158**
10	*Artocarpus heterophyllus*	*	*	*	*	*	2890	**2890**
11	*Artocarpus hirsutus*	*	*	*	*	*	1110	**1110**
12	*Azadirachta indica*	30000	43400	40000	50000	29000	39860	**234260**
13	*Bambusa bamboos* (Grass)	*	500	*	*	*	941	**1441**
14	*Bambusa vulgaris* (Grass)	*	*	*	*	*	295	**295**
15	*Bauhinia purpurea*	300	*	*	*	*	*	**300**
16	*Bauhinia racemosa*	800	900	600	1000	*	*	**3300**
17	*Bauhinia variegata*	*	*	*	*	*	1124	**1124**
18	*Butea monosperma*	*	*	*	*	*	4	**4**
19	*Caesalpinia Pulcherrima*	*	*	*	*	*	991	**991**
20	*Calophyllum pinnatum*	*	*	*	550	*	633	**1183**
21	*Cassia fistula*	700	3500	*	*	*	25	**4225**
22	*Cassia siamia*	*	3900	2100	930	900	*	**7830**

23	*Casuarina equsetifolia*	*	1850	4000	*	*	45501	**51351**
24	*Ceiba pentandra*	500	3520	*	*	550	721	**5291**
25	*Citrus medica*	*	*	*	*	*	152	**152**
26	*Dalbergia latifolia*	*	3450	1700	1000	3000	1862	**11012**
27	*Dalbergia sissoo*	2500	3900	*	*	*	3461	**9861**
28	*Delonix regia*	1700	2500	*	*	*	30	**4230**
29	*Dolichandron falcata*	*	500	*	*	*	*	**500**
30	*Eucalyptus sp.*	*	*	*	*	*	11960	**11960**
31	*Ficus amplicima*	*	300	1000	*	*	*	**1300**
32	*Ficus auriculata*	*	*	*	1200	*	3500	**4700**
33	*Ficus racemosa*	*	1000	*	*	2100	754	**3854**
34	*Ficus religiosa*	250	500	*	*	*	*	**750**
35	Gliricidia sepium	*	300	*	*	*	*	**300**
36	*Gmelina arborea*	*	2200	*	*	2000	3657	**7857**
37	*Holoptelia integrifolia*	*	1500	1000	1200	2000	4150	**10350**
38	*Khaya senegalensis*	*	*	*	*	*	736	**736**
39	*Leucaena leucocephala*	*	*	1630	*	5800	*	**7430**
40	*Madhuca longifolia*	8000	13000	8500	8700	9800	13798	**61798**
41	*Manjifera indica*	*	*	*	*	*	945	**945**
42	*Melia dubia*	20000	47000	30000	42000	37000	25332	**201332**
43	*Mimusops elengi*	1000	2500	*	*	*	35	**3535**
44	*Muntingia calabura*	*	1000	950	*	*	*	**1950**
45	*Murrya koenigii*	*	*	*	*	*	210	**210**
46	*Neolamarckia cadamba*	*	*	*	*	*	4267	**4267**
47	*Parki atimoriana*	*	*	*	*	*	4782	**4782**
48	*Peltophorum pterocarpum*	1500	2000	2000	*	*	*	**5500**
49	*Phyllanthus emblica*	1500	*	*	*	*	945	**2445**
50	*Pithecellobium dulce*	1300	2000	2500	1700	2500	3654	**13654**
51	*Pongamia pinnata*	7200	8000	6000	7100	1800	4283	**34383**
52	*Psidiu mgujava*	*	*	*	*	*	335	**335**
53	*Pterocarpus marsupium*	273	2000	*	*	*	1787	**4060**
54	*Pterocarpus santalinus*	7370	6000	4000	3000	2500	7616	**30486**
55	*Punica granatum*	*	*	*	*	*	145	**145**

56	*Samanea saman*	5000	6000	3200	1600	1800	4510	**22110**
57	*Santalum album*	2450	*	*	*	*	3035	**5485**
58	*Sapindus emarginatus*	1500	935	*	*	550	*	**2985**
59	*Simarouba glauca*	1000	2280	1790	1800	970	2300	**10140**
60	*Spathodea campanulata*	215	*	*	*	*	*	**215**
61	*Swietenia mahagoni*	8000	7500	4000	3500	4500	2168	**32168**
62	*Syzygium cumini*	13,200	18,000	15,000	12,000	13,300	11592	**83092**
63	*Tamarindus indica*	*	2300	1900	1500	1200	5139	**12039**
64	*Tectona grandis*	8700	14400	16000	18500	5500	26721	**89821**
65	*Terminalia arjuna*	9000	4100	4000	7000	2300	1357	**27757**
66	*Terminalia bellarica*	*	1,800	*	*	*	2808	**4608**
67	*Terminalia catappa*	*	1950	1500	*	*	446	**3896**
68	*Terminalia elliptica*	*	*	*	*	*	200	**200**
69	*Thespesia populnea*	3000	3000	2020	2000	*	3051	**13071**
70	*Wrightia tinctoria*	*	2100	1600	*	2000	2000	**7700**
	Total	**1,35,081**	**2,25,185**	**1,55,210**	**1,50,232**	**1,35,120**	**2,53,063**	**10,53,891**

Note: * absence of the species

Azadirachta indica, Melia dubia, Syzygium cumini, Madhuca longifolia, Tectona grandis, Swietenia mahagoni, Terminalia arjuna, Pterocarpus santalinus, Ailanthus excelsa, Pongamia pinnata, Samanea saman, Pithecellobium dulce are the most successful tree species growing in the VT plantations.

Table No 2. Average size of trees growing in different stages

VT STAGE	Avg GBH (cm)	Avg Height (m)
VT1	29	5
VT2	26	4
VT3	20	4
VT4	13	3
VT5	12.	2

The first set of trees planted in VT1 plantations trees attained the maximum growth with an average height of 3.58 m and 19.58 cm at Girth at Breast Height (GBH). The changes in tree growth are related to the species and also to the management of the plantations.

Though many trees are successful, a scientific and ecological approach is needed to select trees species for attaining the maximum result of the efforts. A set of tree species which can grow in the Tirupur soil has been recommended in the appendix no 10.

Vanathukkul Tirupur plantations were established on 2071.2 acres of land distributed in different locations. These plantations include monoculture and polyculture practices. Interestingly as many as 22 species of tree saplings were planted in a single polyculture plantation. Most of the monoculture plantations were with Malabar neem, Neem, and Teak. Recent studies point out that, the diversity of associated flora and fauna is more in polyculture plantations compared to monoculture plantations. So, these polyculture VT plantations may play a vital role in the conservation of the biodiversity of Tirupur urban and rural areas.

An account on the selected Trees in the VT plantations

1. Neem *(Azadirachta indica)*

Neem is a native species of the Indian subcontinent. It is an evergreen species and sheds leaves in heavy drought conditions. It grows in tropical and semi-tropical regions. Many birds feed on neem fruits. The seed is used for extraction of neem oil and timber is used for house construction. It has grown to a maximum girth of 46.65 cm and height of 4 m in VT-1 plantations. It was enumerated that there are 94,400 trees in VT plantations.

2. Malabar neem *(Melia dubia)*

Malabar neem is the most successful tree across all VT plantations. In VT1 plantations, it has reached a maximum girth of 46 cm and 9 m height. Malabar neem is a fast-growing plant that needs periodical watering and is suitable for semi-dry conditions. Now 72,000 trees are alive in VT plantations.

3. Jamun *(Syzygium cumini)*

Jamun is an evergreen tropical tree, also known as Malabar plum, Java plum, or black plum. This is native of the Indian Subcontinent and adjoining regions of Southeast Asia. It grows very slowly and withstands very dry conditions. It has grown up to a maximum girth of 35.53 cm and 3 m height in the VT 1 plantation. There are 71,500 trees planted and successfully growing in VT plantations.

4. Teak *(Tectona grandis)*

Teak is tropical hardwood tree species. It is a deciduous tree native of South and Southeast Asia. It is a commercially important species used as timber wood to make furniture and building houses. It is well adapted to dry regions and needs less water. The trees attained a

a maximum girth of 28 cm and 5 m height in VT 1 plantations. The plantations have 35,600 trees.

5. Mahuwa / Iluppai *(Madhuca longifolia)*

Mahuwa is an evergreen to a semi-evergreen tree. It is a native of tropical mixed deciduous forests of India. It grows well in arid zones and semi-dry plains. The seed butter of this tree is used for cooking purposes and as well as medicine. The trees of the VT 1 phase have a maximum girth of 25 cm and a height of 4 m. 42,000 trees are there in all VT plantations.

6. Mahagony *(Swietenia mahagoni)*

Mahagony is a deciduous and medium to large-sized tree. It is the native of Southern Florida, Cuba, and Jamaica. It is a commercially important species, used as timber wood for house construction and furniture production. It grows well in semi-dry regions. The maximum girth is recorded as 36 cm and the height as 5 m in VT 1 plantations. Totally 23,000 trees are growing in VT plantations.

7. Red sandal wood *(Pterocarpus santalinus)*

Red Sandal Wood is a medium-sized tree endemic to the Southern range of Eastern Ghats. It is a commercially very important species, and hence its rarity. It is used worldwide as timber wood for making luxurious furniture. It grows well in the dry regions and even in degraded soil. 17,170 trees growing in VT 1 plantations have attained a maximum girth of 16 cm and height of 4 m.

8. Indian beech/ Pongam oil tree *(Pongamia pinnata)*

Pongamia is a deciduous tree species native of East Asia, Australia, and the Pacific Islands. It is generally grown along roadsides and in residential areas for good shade and pure air. The seed of this tree is used for bio-diesel production. The maximum girth of the tree of VT 1 plantations is 38 cm and the maximum height is 4 m. Totally 14,500 trees are present in VT plantations.

9. Manila tamarind/Madras thorn *(Pithecellobium dulce)*

Pithecellobium is a deciduous tree species. It is native of the Pacific coast, Mexico and North America. Many birds are attracted by the fruit. It grows well in dry regions and all types of soil. The trees of the VT1 phase attained a maximum girth of 28 cm and height of 3.51 m.

`There are a total of 10,000 trees in all VT plantations.

10. Marudha maram/Neer maruthu *(Terminalia arjuna)*

It is an evergreen species that usually grows in river beds/banks. It is a native of India and Sri Lanka. It is used as a medicinal plant as well as an ornamental tree. It was measured up to the maximum girth of 28cm and height of 3.39 m in VT 1 plantations. There are 17,400 trees totally in all VT plantations.

11. Agal perumaram *(Ailanthus excelsa)*

This is a large deciduous tree. It is also known as Tree of heaven and Pi-nari maram, as it has a disagreeable odour. It is native to India and Sri Lanka. It is grown in the edges of the fields and rivers to prevent soil erosion. It has medicinal properties and is used in the match stick industry. The trees of VT 1 plantations attained the maximum girth of 26 cm and height of 3 m. It is estimated that 15,000 trees are there in all VT plantations together.

12. Simarouba *(Simarouba glauca)*

Simarouba is a flowering plant species that grows in warm, humid, and tropical regions. It is called Lakshmi taru, Paradise tree and Dysentery bark. It is a native of South America. The wood is insect resistant, and hence it is used in making furniture. It grows well in semi-dry regions. It is estimated that the trees growing in VT plantations have reached maximum girth of 34 cm and 4 m height. There are 6,840 trees planted and successfully growing in VT plantations.

13. Saman / Rain tree *(Samanea saman)*

Rain Tree is an evergreen tree species. It is a native of Central and South America. It grows with good canopy cover and gives good shade, and so it is grown along the roadsides and in public places. It has attained a maximum girth of 33 cm and height of 4 m in VT plantations and there are 11,100 trees present in all the plantations together.

14. Rose wood *(Dalbergia sissoo)*

Rosewood is a medium to the large deciduous hard tree. It is grown as a timber wood tree and is used in house construction. It is native of the Indian Subcontinent. It grows along river banks in the regions with medium rainfall. There are trees 6400 trees growing in the plantations with maximum girth of 28 cm and height of 4 m.

15. Copper pod tree *(Peltophorum pterocarpum)*

Copper pod tree, is a deciduous tree that is also called as Yellow flame tree, and Yellow Poinciana. It is a native of tropical Southeastern Asia and Northern Australia. It is grown as an ornamental tree all over the world. In VT 1 plantations, the trees have grown up to a maximum girth of 27 cm and 4.5 m height. There are 5,500 live trees in VT plantations.

16. Casuarina/ Whistling pine *(Casuarina equisetifolia)*

Casuarina is native of Southeast Asia, Northern Australia, and Pacific Islands. It is also called the Australian pine tree and Whistling pine tree. It is used as a construction pole to build sheds. It grows well in all types of soil. In VT 2 phase, the trees have attained a maximum girth of 20 cm and 6.8 m height. Totally 5,850 trees are growing in VT plantations.

17. Golden shower *(Cassia fistula)*

Cassia is a tree species of tropical and subtropical regions with very attractive inflorescence. It is a native of India and adjacent Southeast Asian countries. It is commonly called a Golden shower and Indian laburnum. It is grown as an ornamental plant and as a medicinal plant. It blooms in late spring and summer with yellow flowers, which surround the whole tree. It grows well in very drought conditions and also is salt tolerant. The trees grew up to the maximum girth of 21.5 cm and the maximum height of 5 m in VT 1 plantations. There are 4,200 trees present in all phases of VT plantations together.

18. Beedi leaf tree *(Bauhinia racemosa)*

This is a rare species of flowering shrub and is native of Southeast Asia. It has religious significance in India. Leaves of this plant are used to make the thin Indian cigarette locally called Beedi. The trees of the VT 1 phase grew up to maximum girth of 25 cm and 3.5 m height. 3,300 trees are present in all phases of VT plantations.

19. Muntingia *(Muntingia calabura)*

Muntingia calabura is an evergreen shrub species. It is a native of Mexico. It is commonly known as Company pazham, Singapur cherry and Sugar fruit. The fruit of this tree is preferred by many birds. It is usually grown as an ornamental tree in the roadsides. It grows quickly in the dry regions. The maximum girth is measured as 26 cm and height as 4.5 m in VT 2 phase. There are 1950 trees present in all VT plantations.

20. Gulmohar *(Delonix regia)*

Gulmohar is a flowering plant species native of Madagascar. It is grown as an ornamental tree in tropical parts of the world. In India, it gives food for the nectarivorous birds. It grows very quickly and withstands in dry conditions. It grew up to an maximum girth of 28.5 cm and an maximum height of 4.5 m in VT 1 plantations. It was estimated that there are 1,700 trees totally in all VT plantation.

21. Bat Fig *(Ficus amplissima)*

Ficus amplissima is a large evergreen and semi-deciduous tree species. It is native of Central, Southern India, Sri Lanka, and the Maldives. It is endemic to the Western Ghats. It is commonly known as the Indian Bat tree and Indian Bat fig. During spring, the ripened fruits of this tree attract many birds. It is tolerant of moderate drought. The trees reached the maximum girth of 31 cm and height of 4.28 m in VT 2 plantations. There are 1,300 trees maintained in all VT plantations together.

22. Butterfly tree *(Bauhinia purpurea)*

This is small to the medium-size deciduous tree, native of the Indian subcontinent and Myanmar. It grows in tropical areas of the world. It is commonly called an Orchid tree, Purple Purple bauhinia, Camel's foot, Butterfly tree, and Hawaiian orchid tree. It is preferred by the nectarivorous birds. It grew to a maximum girth of 30.32 cm and height of 5 m in VT 1 plantations. There are a total of 300 live trees in all VT plantations.

23. Indian kino tree *(Pterocarpus marsupium)*

This is a medium to the large deciduous tree native of India, Nepal, and Sri Lanka. It is used as timber wood for house construction and furniture. These trees in the VT plantations have grown to maximum girth of 32 cm and height of 5 m. There are a total of 273 trees in all VT plantations.

24. Pipal tree *(Ficus religiosa)*

Pipal tree *(Ficus religiosa)* is a deciduous tree species native of India and Indochina. It is worshipped by people of three religions viz., Hinduism, Buddhism, and Jainism, originated from India. It is believed that Prince Siddhartha got enlightenment under the sacred fig tree and transformed as Gautama Buddha. These trees in the VT 1 plantations have grown to a maximum girth of 33 cm and height of 6 m in VT 1 plantations. There are 750 trees alive in all VT plantations.

25. Bamboo *(Bambusa bambos)*

Bambusa bambos is a tall and green colored bamboo species. It is also called as giant thorny bamboo and Indian thorny bamboo. It is the native species of Southern Asia. It naturally grows in the dry zones of the forest, so it is suitable to grow in dry regions. The trees of VT 2 plantations have 14 cm maximum girth and 7 m height. There are a total of 500 trees in all VT plantations together.

Plantation on Birthday of our volunteer

BIODIVERSITY AUGMENTATION

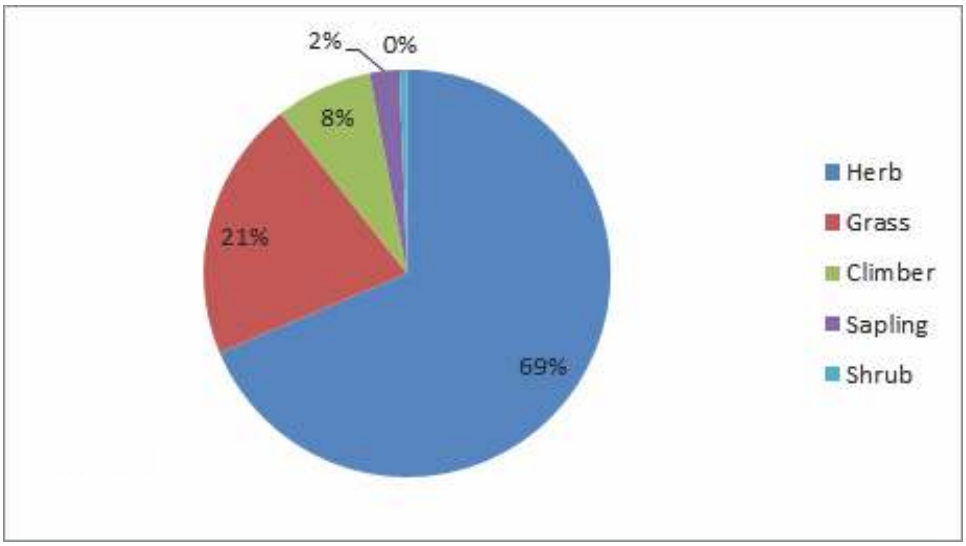
VEGETATION

From the 70 plantations selected for intensive study, vegetation details were collected using the quadrate sampling method. In total, 263 species of flowering plants were identified including the 70 species planted by the VT programme (Table 3). Of these, 84 species were trees (Appendix 1) and 169 species belonged to herbs, shrubs, and climbers (Appendix 2).

Table 3. Plant diversity of the selected VT plantations studied

VT STAGE	Planted trees in the studied plantations	Quadrates sampled	Species richness	Abundance
VT1	83620	39	91	855
VT2	92305	56	135	1685
VT3	17600	13	50	437
VT4	5400	09	51	231
VT5	14000	05	23	137

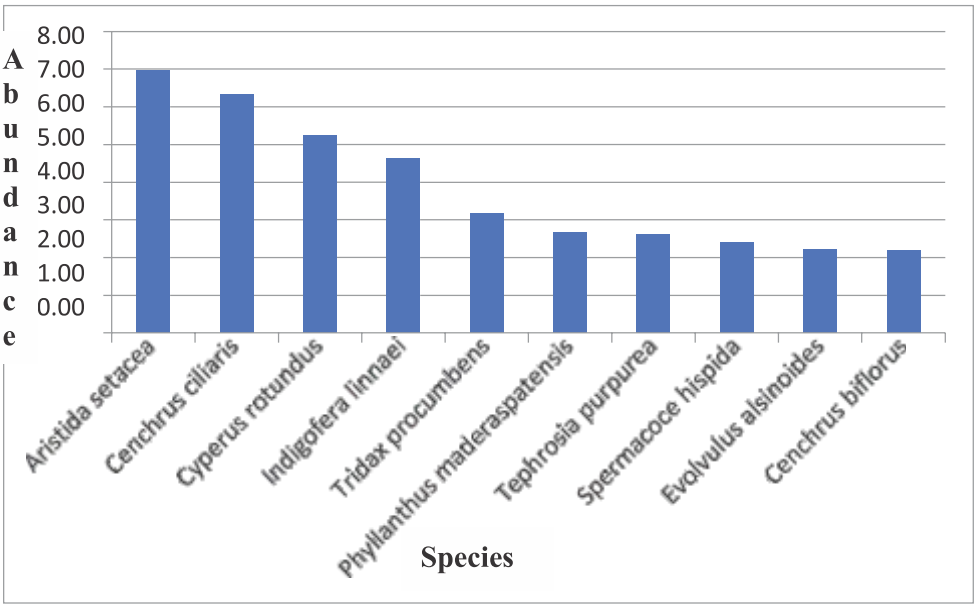
Figure 5. Different types of plants recorded in the VT plantations



These lands were either barren or uncultivated fallow lands before the VT planting. Considering this, the return of natural vegetation in the ecological succession triggered by the VT programme is remarkable. Planting lakhs of trees has created an ecological infrastructure for a large number of insects, reptiles, birds, and mammals. Soil which was barren and exposed to sun and wind is now covered with ground vegetation and canopy of the trees. This helps in retaining the moisture, organic carbon, micro flora and fauna, and further positive development of the land towards a fertile one.

It is observed that, at first, the land amongst the growing tree saplings were getting covered by herbs and grasses and eventually by tree samplings via the seeds brought though bird droppings or wind. Another interesting observation in the VT plantations is that the regular weeds prevalent in other open areas such as Parthenium, Lantana, or Chromolaena are relatively very less in the VT plantations. Probably the fencing and the protection from cattle and other regular human disturbances may be the cause of the dominance of wild herbs and shrubs over the weedy plants in the areas. Growth of the planted trees as well as the overall biodiversity is directly proportional to the extent of protection, watering of planted trees, and care taken by the people. However, there are rare instances recorded as some of the caretakers removed the ground vegetation and kept the site "neat and clean" without much biodiversity except the planted trees.

Figure 6. Ten most abundant plants in VT plantations.

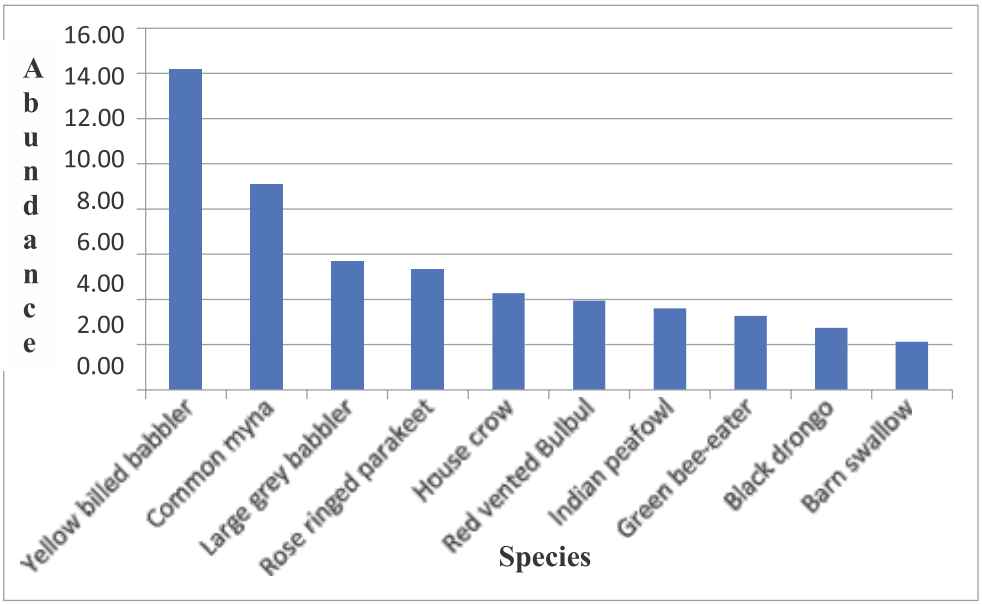


Million Tree Completion with team of Volunteers

BIRDS

From all the 70 plantations sampled 79 species of birds were recorded in this short one-time survey (Appendix 3). Of these, 12 were recorded from plantations of the five VT phases. Detailed sampling was conductes in the first five VT phases only. Another 14 of them spotted in four of the five phases. As they have sighted in plantations of all the phases, these can be considered as common in VT plantations of Tirupur. Among the remaining species, some are specialists to forested areas. Such birds are giving enough indications that how the VT plantations are attracting rare birds. Definitely, there is a progressive succession of the micro-ecosystem in many VT plantations towards of good quality secondary forest. Sighting of White-rumped Shama *(Copsychus malabaricus)*, a wonderful songbird, normally seen in densely vegetated habitats, from one of the plantations (VT1, M/s Swamy Cotton, Vellampalayam) and birds like Paradise flycatcher, Ioras, Minivets, Barbets, and Woodpeckers in many plantations indicate the positive direction of ecological succession the VT programme has taken. Appendix 3 gives the list of all bird species recorded from the intensive study plantations in one season and figure 7 gives the ten most abundant bird species in those locations.

Figure 7. Ten most abundant birds in the VT plantations



Birds are effective indicators because they respond to habitat changes at various scales, due to their functional links to other taxa that respond to any disturbance. So it is apparent that bird monitoring programs provide useful information about the integrity and functioning of the

environment as a whole. The surveys in the selected VT plantations show a clear progressive association between the growth of the plantations and birds. Growing trees in these plantations provide perching, foraging, and nesting opportunities for the birds and serve as green shelters for the birds of this region. Most of the birds encountered in the VT plantations are common and more generalist species.

Figure 8. Taxonomic composition of the birds from selected VT plantations

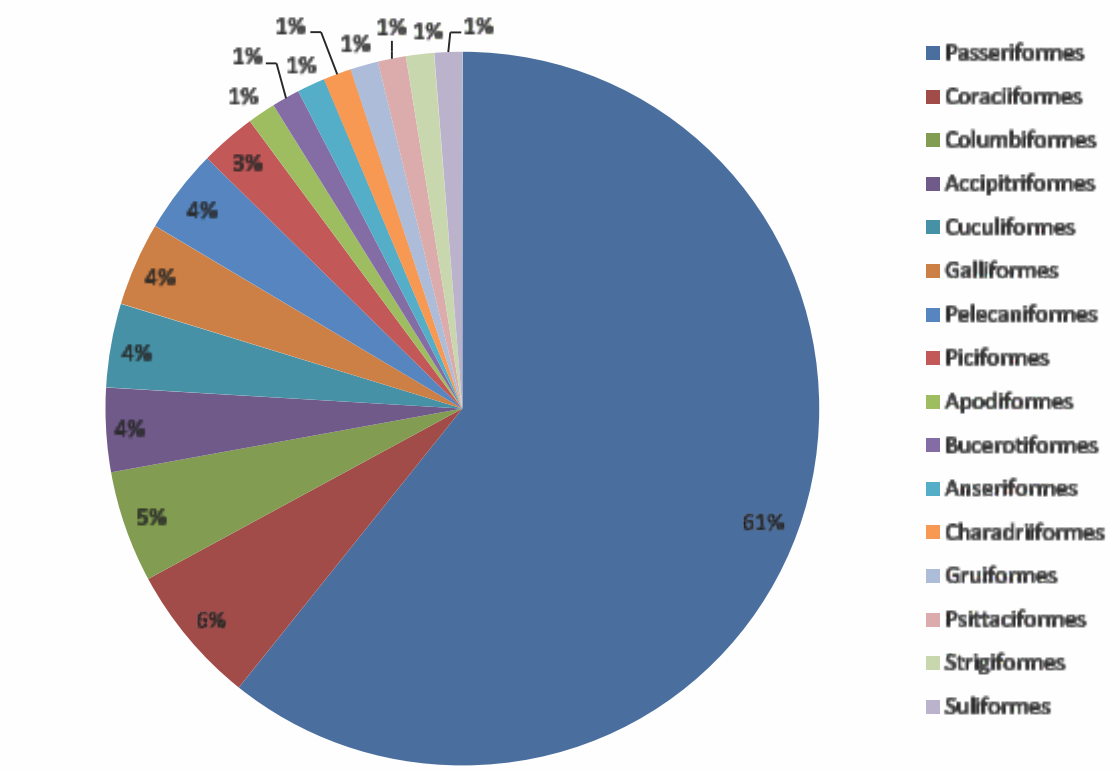
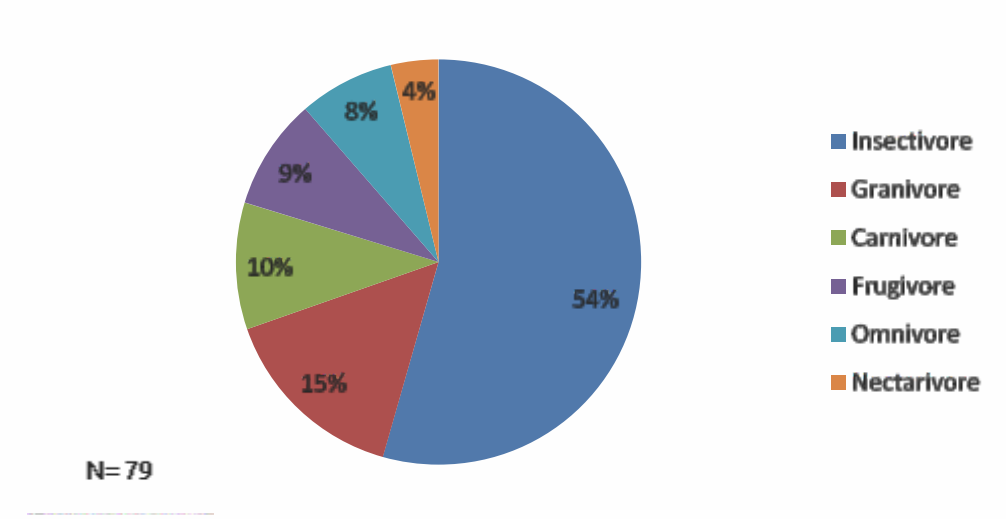


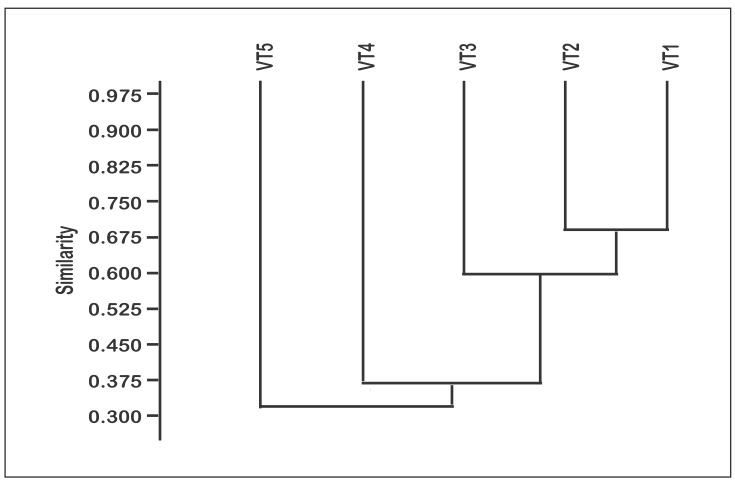
Figure 8 gives the taxonomic composition of the bird community in VT plantations. When we compare the taxonomic composition, as expected Passeriformes (61%) dominates in the plantations followed by Coraciiformes (6%) and Columbiformes (5%).

Figure 9. Feeding guild composition of birds in selected VT plantations



The feeding guild composition (Figure 9) among the tree plantations shows the domination of insectivores birds (54%) followed by granivores (15%) and carnivores (9%).

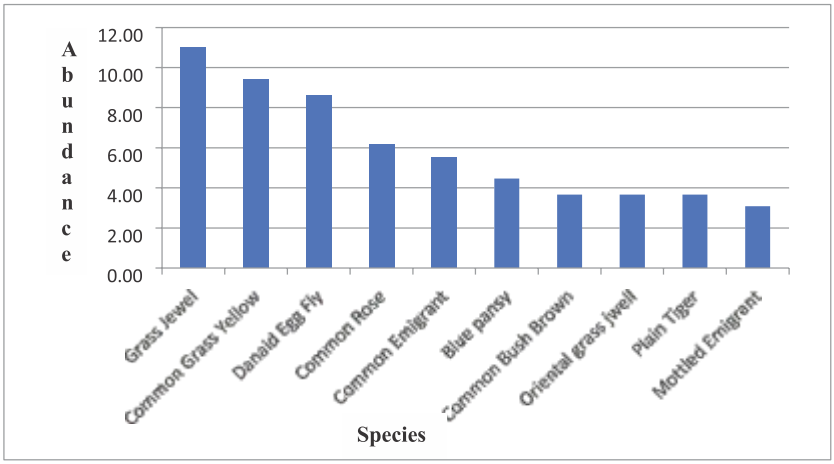
Figure 10. Clustering of VT plantations phases based on the similarity of the birds they support



When the similarity of the bird communities of different phases was computed using the Jaccard similarity index the clustering gives a very interesting figure (figure 10); linear colonization of bird species as per the sequence of the VT programme indicating the return of birds in the VT plantations are gradual.

Identifying tree-species preferences of foraging birds is very important for conservation,

Figure 12. Ten most abundant butterfly species of VT plantations



particularly in habitat restoration. It is also important that bird-attracting plant species need to be preferentially planted to facilitate enhancing plant diversity and thus the formation of more diverse microhabitats. As a vital component of ecosystems, birds are important seed dispersers, pollinators and predators. Hence their requirements should be a priority in any habitat restoration projects. Active planting of fruiting and canopy trees might be an effective way for a successful eco-restoration.

Valedictory Function on 17.12.2016 after Plantation of 3.6 Lakh Trees. Dignatories L-R Mr Anish - Director - Dinamalar / Padma Shree Mr Vivek - Cine Actor / Padma Shree Dr A Sakthivel - Chairman - AEPC / Mr Raja Shanmugam - President - TEA / Mr Gopalakrishnan - Chairman - Royal Classic Groups

BUTTERFLIES

Sixty-five species of butterflies were recorded from the intensive study sites. The taxonomical composition of the butterfly community is given in figure 11. Of these, 8 were recorded from all the VT phases and another 10 were spotted in four of the five phases. These species altogether can be considered as common in VT in Tirupur. Most of our surveys were conducted during the dry periods of summer and hence not the main butterfly flying periods. Without a survey during the monsoon, the list will not be complete. However, during these surveys, 65 species recorded is an indication of the rich butterfly diversity the area supports. Appendix 4 gives the list of all the butterfly species recorded, and Appendix 5 their host plants. Figure 12 gives the ten most abundant butterfly species in the VT plantations. The mean number of butterfly species among the plantations of five phases is given in figure 13. It shows a progressive increase with the years of growth.

Figure 11. Taxonomic composition of butterfly community of VT plantations

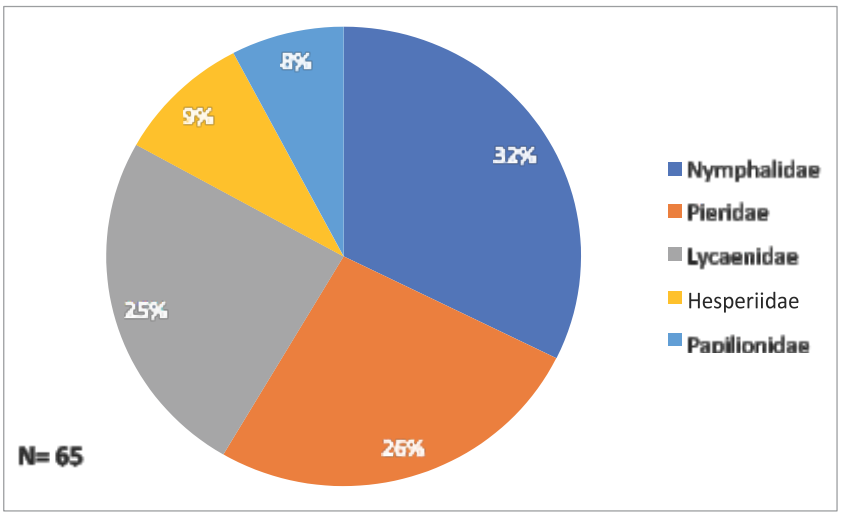
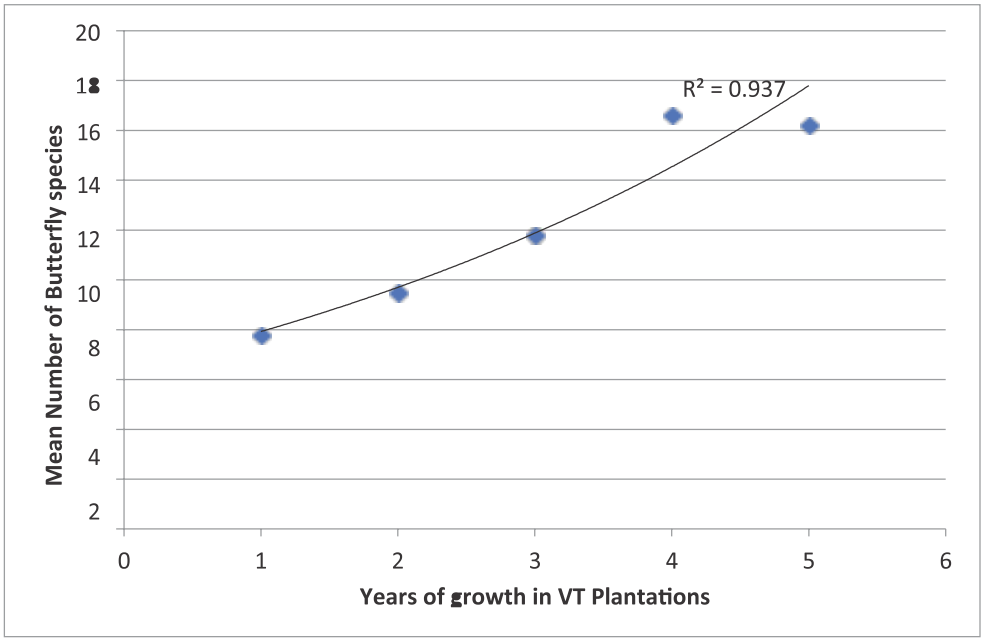


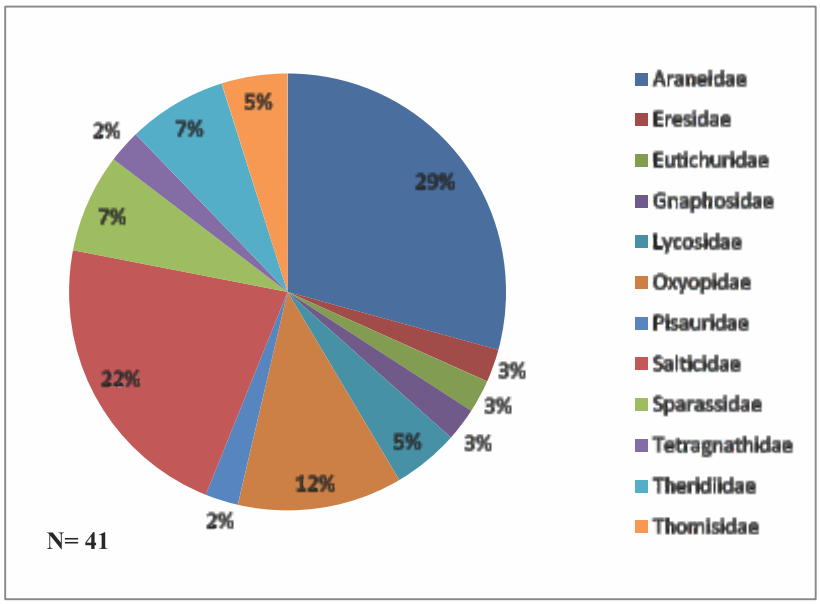
Figure 13. The Trend in butterfly diversity changes in VT plantations.



SPIDERS

In total, 41 species of spiders were identified from the sampled VT locations (Appendix 6). As in the case of other taxa, more spiders as well as more species were sighted in VT-2 plots. Family wise taxonomic compositions of spiders are shown in figure 14. Spiders play a dynamic role in any ecosystem. High agility, reproductive rate and longevity of spiders, contribute towards the success as a prominent biotic component in the ecosystem. Sexual dimorphism among spiders is very predominant and invariably the females are large compared to their male counterparts. The last few decades have witnessed intensive destruction of tropical forests and replacement by other more homogenous types of vegetation. Spiders help in biological control of insects; without spiders, some insects would have reached pest proportions. Spiders belonging to different kinds of niches have already colonised the woodlands created by VT Plantations.

Figure 14. Taxonomic composition of spiders in VT plantations



Opportunistic observations

Opportunistic observations of many other groups of organisms were also recorded during the survey. Appendix- 7, 8 and 9 give such information on odonates, mammals and reptiles. The ground vegetation and trees created hideouts and foraging places for many animals like black napped hare, palm squirrel, snakes, lizards and geckos. The absence of water bodies probably is the reason for the very limited number of odonates and amphibians in these locations. The presence of all these species in VT plots indicates that the emerging vegetation could provide habitats for many organisms.

CARBON SEQUESTRATION

It is estimated that the Earth's mean temperature may increase by 1.5–5.88oC by the twenty-first century (IPCC 2001) and a sea-level rise up to 15–23 cm during the twentieth century (IPCC 2007). The anthropogenic activities such as land-use change, deforestation, biomass burning, draining wetlands, soil degradation, fossil fuel combustion, etc., is consistently increasing the emission of greenhouse gases. Carbon sequestration is the removal, capture, or sequestration of CO2 from the atmosphere to slow or reverse atmospheric CO2 and mitigate global warming. Afforestation and reforestation programs are the most practiced and straightforward way for carbon sequestration. Large scale afforestation programs are being practiced worldwide to reduce global warming. Afforestation in barren lands increases the national natural capital of the country (Ravindranath et al., 1997). VT programme in every sense is one such successful programme which contributes to the global carbon sequestration movement as well as increasing the natural capital of the country.

Estimates of carbon accumulated by the VT programme were estimated by standard procedures prescribed by FAO and IPCC (http://www.fao.org/3/w4095e/w4095e06.htm; FSI, 1996). First, the total biomass of the planted trees above and below the soil were calculated, and then total carbon and carbon dioxide sequestrated while building up the biomass is measured (Haripriya, 2000; Gibbs et al., 2007). Wood density values for species are obtained from the website (http://www.worldagroforestry.org/).

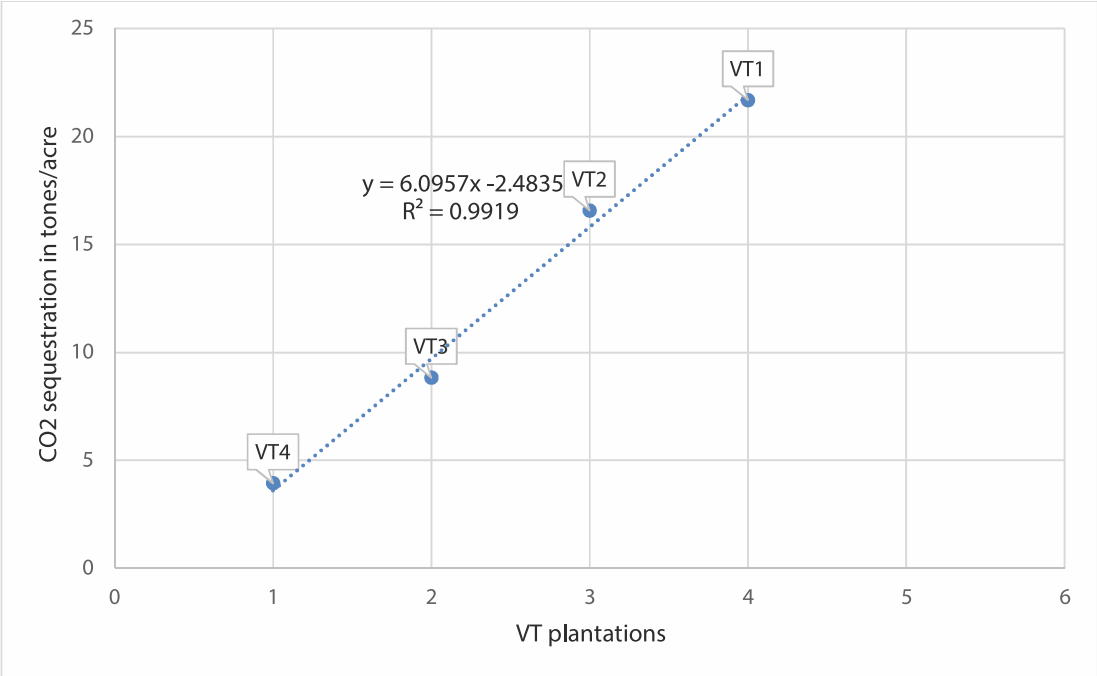
Table 4. Total carbon and CO2 sequestered in VT plantations at present

VT STAGE	TREES ASSESSED	TOTAL AREA(HA)	TOTAL BIOMASS (METRIC TONS)	TOTAL CARBON CAPTURE (METRIC TONS)	TOTAL CO2 SEQUESTERED (METRIC TONS)	TOTAL CO2 SEQUESTERED/ HA/METRIC TONS
VT1	89281	131.57	1576	788	2852.56	21.68
VT2	167985	172.59	1580	790	2859.8	16.57
VT3	119590	135.27	660	330	1194.6	8.83
VT4	92480	119.4	260	130	470.6	3.94
Total	**469336**	**558.83**	**4076**	**2038**	**7377.56**	-----

The total VT programme has accumulated more than 4000 metric tons of biomass and sequestrated more than 7000 metric tons of carbon dioxide from the air. Details of the carbon calculation are given in Table 4. Many international studies have documented the carbon sequestration of tree plantations for over 20 years. Studies in other countries have demonstrated that planted forests and woodlots were

sequestered Carbon dioxide ranging from 4.5 to 40.7 metric tons per hectare per year in 20 years of growth. As of now the four and five-year-old VT plantations have sequestered more than 10-20 metric tons of Carbon dioxide per hectare (Figure 15). Considering the growth of biomass accumulation and CO2 sequestration of this programme definitely is going to do better in future.

Figure 15. Carbon sequestration trend in VT plantations



Taking into consideration of the average overall growth of trees in VT plantations and the rate of carbon sequestration per hectare per year and the overall CO2 sequestration by VT plantations (Figure 15 and Figure 16) the following trends are expected.

- Maintenance of existing VT plantations with existing trees for the next four more years will result in the sequestration of 38 thousand tones of CO2 from the air.
- Continuation of the VT programme in the same magnitude will add another seven thousand tones making it into 45 thousand tones of CO2 sequestration form the overall programme in 10 years by 2025.
- It is also demonstrated that mixed plantations sequester more carbon /ha than monoculture. So it is always good to go for polyculture wherever it is possible.

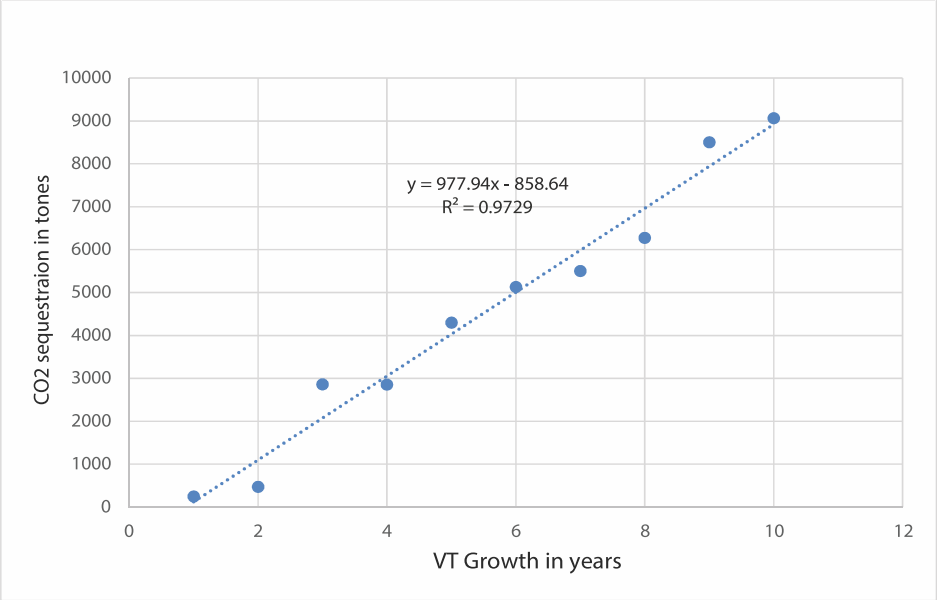


Figure 16. Projected trend in Carbon sequestration in 10 years of VT plantations in the current magnitude.

OXYGEN REPLENISHMENT

Hon'ble Supreme Court of India observed on 9th January 2020 that the time had come to calculate the environmental cost of trees by taking into account the volume of oxygen they contribute to the atmosphere in their lifetime. A bench of Chief Justice SA Bobde and Justice BR Gavai and Justice Surya Kant said, "Why do authorities while computing environmental compensation, not take into account the volume of oxygen a tree would release into the atmosphere in its lifetime? Look at the amount of oxygen generated by a single tree in its lifetime. The value of oxygen generated by a tree in its lifetime should be taken into account in determining damage to the environment caused by its felling."

As a general rule, a single matured tree absorbs around 21.77 Kg (44 pounds) of carbon and releases oxygen back to the atmosphere which is enough for sustaining the oxygen demand of two people (www.thoughtco.com/how-much-oxygen-does-one-tree-produce-606785). So it is a thumb rule that the total requirement of trees in an area = Total population of that place / 2. One acre of afforestation can provide oxygen need for 18 people for a year, 100 kg of oxygen per tree per year. Hence, when all the trees of the present VT plantations mature the contribution of the VT programme to the world will be substantial. However, the calculation of an even approximate amount of oxygen replenishment to the atmosphere by the plantations needs more focused research.

SOIL TRANSFORMATION

Soil properties in the plantations were studied during this survey. Samples were collected from 60 plantations of various VT Phases. For every sample from the VT plantations, a soil sample (control) was collected from the nearby open area to compare and elucidate the difference of soil parameters if any between the regions. The results are given in table 6. The samples from VT 3, VT 4, and VT 5 do not show any significant changes in the chemical parameters, though there are changes in physical parameters such as texture, softness, and water-retention capacity. However, VT 1 and VT2 soils have shown some minor positive changes in total carbon content, electrical conductivity, Nitrogen, Phosphorous, Potassium, and pH, though these were not statistically significant. For more significant changes in chemical parameters, proper ecological succession with the development of microflora and microfauna has to happen in the soil and it is likely to take time. It has been widely seen that while denudation of soil could happen fast, its qualitative recovery would take longer with positive interventions aiming at the preservation of the soil substrate and biological replenishment. Thus, in the case of VT, it may take a few more years. However, the current trends are evidence for the evolving vegetation and ensuing ecological succession is positively molding the land into a more fertile one where more life can come and succeed.

Table 5. Soil parameters and its changes from VT plantations

Parameters	**VT1 Control**	**VT1 Sample**	**VT2 Control**	**VT2 Sample**
pH	7.93 ± 0.47	7.89 ± 0.55	7.88 ± 0.54	7.82 ± 0.46
Electrical conductivity	0.10 ± 0.054	0.14 ± 0.16	0.10 ± 0.06	0.21 ± 0.22
Nitrogen	192.93 ± 49.72	248.10 ± 48.33	215.03 ± 142.75	223.89 ± 48.63
Organic carbon	0.27 ± 0.21	0.41 ± 0.27	0.32 ± 0.22	0.44 ± 0.26
Phosphorous	12. 56 ± 3.57	16.84 ± 3.82	14.80 ± 7.58	15.77 ± 3.78
Potassium	202.36 ± 36.00	216.23 ± 43.81	199.84 ± 38.69	218.77 ± 39.19
Number of samples	19	46	19	54

RETURN OF NATURE AND LIVING AMBIANCE

Clear scientific evidence of the "Return of nature and natural processes" is the Vanathukkul Tirupur programme's real value. Through the programme, VETRY has planted and successfully maintaining one milllion trees in the region. That process augmented biodiversity, started changing the soil structure and sequestrated a significant amount of carbon dioxide from the air. It will eventually start to impact the quality of groundwater, likely to change the ambient temperature of the area, reduce noise pollution, air pollution, and water pollution. The net result of all these is the qualitative improvement of living space of Tirupur for humans as well as numerous wild species. Vanathukkul Tirupur is a process that catalyses the return of nature to the area. Tirupur in real sense is going to become “TIRUPUR - a place of return of nature”, and show the world that that return is possible.

LIVELIHOOD SUSTAINABILITY

In the post COVID world, people started thinking about their roots and location-based sustainability. The basic feature of sustainability as regards humans is a regular and sustained income, in addition to environmental security. The potential of the biomass and biodiversity to ensure the welfare and sustainable regular income has to be explored. This may require a better understanding of the biodiversity of the area, awareness creation, and development of ecologically and economically viable infrastructure and facilities for such self-reliant developmental programmes.

Trees and biodiversity can provide additional financial support and means of livelihood during difficult times. This potential of the trees and forests should be well recognized and the larger public is made well aware of it to deal with unexpected catastrophes such as the present pandemic, other challenging situations, or disasters.

HEALTH BENEFITS OF PROXIMITY TO FORESTS

There are studies that prove that spending time in Nature significantly reduced body inflammation. Our natural immune system is still the most sophisticated security system available to us protecting us from various diseases from time to time. Due to the millions of years of co-evolution, our life learned to immunize itself to infectious diseases. The immune system of the forest dwellers evolved in concert with the immune system of the forest which

which is much better than many of the urban people. Even though we have destroyed most of our forests, the remaining forests still offer us an incredible immune boost. Nearly 1,000 scientific studies "point in one direction: Nature is not only nice to have, but it's a have-to-have for physical health and cognitive function," according to the Yale School of Forestry & Environmental Studies (Robbins, 2020).

A MODEL OF PARTICIPATORY AFFORESTATION

Vanathukkul Tirupur provides a model. A model of participatory afforestation that can be adopted anywhere. The uniqueness of this model is the involvement of people of different walks of life such as industrialists, farmers, nature lovers, forest departments, schools, and colleges.

Prime reasons for the success of this programme are five "P"s: Passion, Planning, Protection, Promotion, and Perseverance. During our study, we felt the same **Passion** in all the members we met. **Planning** and execution of the schedule of planting, watering, and monitoring is done with a missionary zeal. In all the plantations excellent **Protection** is given to the plants and it is regularly monitored. Vanathukkul Tirupur programme has given excellent **Promotion** among the people so that there are enough people to help and support. Most significant of all these factors is the **Perseverance** the leadership shows.

Even amidst the social trauma of Pandemic Covid-19, they were not idle. They have planted 6th VT and reached one million trees target. This effort against the pandemic shows their determination not to succumb to any adversities.

Potential of Vanathukkul Tirupur programme

- This programme has the great potential ahead to bring together the larger community of Tirupur under one umbrella for coordinated action for nature conservation and sustainable development
- This can be a platform for education, training, research, and exchange of information regarding nature and the environment.
- In the immediate future developmental programmes have to be socially meaningful, economic pragmatic, and environmentally sensible.
- This programme can advise authorities for example the do's and don'ts of prudent land-use, and urban planning.

- Continuous cleaning of our immediate air and water and improvement of the fertility of soil and reduction of noise pollution.
- It provides the habitat for a large number of wildlife in the immediate surroundings.
- It opens up the potential for nature-based tourism and the environmental awareness programs for all sections of the society, especially for school and college students.

Recommendations

- The choice of plants may be refined; more native trees based on the soil and water availability should be selected.
- Polyculture or multispecies planting which are compatible and with ecological complementary roles should be encouraged.
- Plant more fruiting flowering and shade trees which will attract more birds and other animals to the area.
- The usage of pesticides and herbicides should not be encouraged.
- Protect the plantations from fire incidents.
- Avoid grazing; if required, controlled grazing can be allowed
- Encourage agro-pastoral activities in the plantations.
- Various silviculture techniques such as the Miyawaki methods should be tried, and tree species with good growth rates as well as ecological importance can be mixed irrespective of the area under plantations
- Developing rainwater harvesting facilities wherever possible.
- Tree plantations for rural development require a careful species selection with a view on adaptability for mass cultivation.

First Plantation at Our Organic Farm School on 26.01.2019 by Mrs Shanthi Duraisamy - Sakthi Masala, Erode Mr Soundararajan - Chairman - CRI Pumps, Coimbatore accompanied by Mr Chandran - Chairman - Eastman Group of Companies - along with our Volunteers

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Dr. Vijaya Karthikeyan IAS - District Collector, Tirupur being honoured by Mr Gopalakrishnan - Chairman - Royal Classic Group - accompanied by Mr Kumaresan - Pasumai Vikatan.

APPENDIX

Appendix 1. Checklist of total trees recorded from the intensive study plots of VT plantations

S. No	Species name	Occurrence				
		VT1	VT2	VT3	V4	VT5
1	*Acacia leucoplia*	*		*		
2	*Acacia sp.*	*				
3	*Adina cordifolia*		*	*	*	*
4	*Aegle marmelos*			*		
5	*Ailanthus excels*	*	*	*	*	
6	*Ailanthus trisphysa*	*	*			*
7	*Albizia amara*			*		
8	*Albizia lebbeck*			*		
9	*Aldinia cordifolia*				*	*
10	*Annona muricata*	*				
11	*Annona squamosa*				*	
12	*Azadirachta indica*	*	*	*	*	*
13	*Bambusa bamboos*		*			
14	*Bauhinia purpurea*	*				
15	*Bauhinia racemosa*	*	*			
16	*Borassus flabellifer*		*			
17	*Calophyllum pinnatum*				*	
18	*Carica papaya*			*		
19	*Cassia fistula*	*	*			
20	*Cassia siamea*		*	*		
21	*Casuarina equisetifolia*		*	*		
22	*Catunaregam spinosa*	*				
23	*Ceiba pentandra*	*	*			
24	*Commiphora berryi*		*			
25	*Cordia sebastena*	*				
26	*Dalbergia latifolia*	*	*	*	*	*
27	*Dalbergia sissoo*	*	*			
28	*Delonix regia*	*				
29	*Dolichandron sp*		*			
30	*Ficus amplicima*	*		*		
31	*Ficus auriculata*				*	
32	*Ficus racemosa*		*			
33	*Ficus religiosa*	*	*			
34	*Gliciridium sepium*		*			
35	*Gmelina arborea*		*	*		
36	*Holoptelea integrifolia*	*	*	*		
37	*Leucaena leucocephala*	*	*	*		
38	*Madhuca longifolia*	*	*	*		

39	*Malphigia sp.*				*	
40	*Mangifera indica*	*	*		*	*
41	*Melia dubia*	*	*	*	*	
42	*Mimusops elengi*		*			
43	*Moringa oleifera*	*	*			
44	*Muntingia calabura*	*	*			
45	*Peltophorum pterocarpum*	*	*	*		
46	*Phyllanthus acidus*		*			
47	*Phyllanthus emblica*		*			
48	*Pithecellobium dulce*		*	*		
49	*Pongamia pinnata*	*	*	*		
50	*Prosopis juliflora*	*	*			
51	*Psidium gujava*		*		*	
52	*Pterocarpus marsupium*	*				
53	*Pterocarpus santalinus*	*	*	*	*	*
54	*Samanea saman*	*	*	*		
55	*Sandalum album*	*				
56	*Sapindus emarginatus*		*			
57	*Sesbania sesban*				*	
58	*Simarouba glauca*		*	*		
59	*Spathodea campanulata*	*				
60	*Stericulia foetia*				*	
61	*Sugar fruit*			*		
62	*Swietenia mahagoni*	*	*	*	*	*
63	*Syzygium cumini*	*	*	*		
64	*Tamarindus indica*	*	*			
65	*Tectona grandis*	*	*	*	*	*
66	*Terminalia arjuna*	*			*	
67	*Terminalia bellarica*		*			
68	*Terminalia catappa*	*	*			
69	*Thespesia populnea*	*	*			
70	*Vachellia leucophloea*	*	*			
71	*Wrightia tinctoria*	*				

Note : * presence of the species

Appendix 2. Checklist of plants recorded from intensive study plantations of VT Programme

S No	Species name	Occurrence				
		VT1	VT2	VT3	VT4	VT5
1	*Abutilon indicum*		*			
2	*Acacia leucoplia*		*			
3	*Acalypha indica*	*	*			
4	*Acanthospermum hispidum*		*			
5	*Achyranthes aspera*	*	*			
6	*Aerva javanica*	*	*	*		*
7	*Aerva lanata*		*		*	
8	*Allmania nodiflora*	*	*	*	*	
9	*Alysicarpus bupleurifolius*			*		
10	*Alysicarpus monilifer*		*	*		*
11	*Alysicarpus ovalifolius*		*		*	
12	*Alysicarpus vaginalis*	*	*		*	
13	*Andrographis echinoides*				*	
14	*Aristida adscensionis*		*	*		*
15	*Aristida funiculata*		*	*	*	
16	*Aristida hystrix*	*	*	*		
17	*Aristida setacea*	*	*	*	*	*
18	*Arundinella pumila*		*			
19	*Azadirachta indica*	*	*			*
20	*Barleria cristata*			*		
21	*Barleria prionitis*	*	*			*
22	*Blepharis integrifolia*	*	*		*	
23	*Blepharis maderaspatensis*	*	*			
24	*Blumea mollis*		*	*		*
25	*Boerhavia diffusa*	*	*		*	
26	*Boerhavia erecta*	*	*		*	
27	*Bothriochloa pertusa*		*			
28	*Brachiaria ramosa*	*	*		*	
29	*Brachiaria setigira*	*				
30	*Bulbostylis barbata*	*	*	*	*	*
31	*Cajanus scabrioides*	*	*		*	
32	*Cajanus sp.*	*				
33	*Calotropis procera*			*		
34	*Capparis sepiaria*	*				
35	*Caralluma adscendens*		*			
36	*Cardiospermum halicacabum*		*			
37	*Caryota urens*		*			
38	*Cassia absus*		*	*	*	
39	*Cassia auriculata*		*			
40	*Catharanthus pusillus*	*	*		*	
41	*Celosia argentea*		*		*	
42	*Cenchrus biflorus*	*	*			*
43	*Cenchrus ciliaris*	*	*	*		

44	*Chloris barbata*		*			
45	*Chrysopogon asper*	*	*			
46	*Chrysopogon fulvus*		*			
47	*Chrysopogon sp.*			*	*	*
48	*Cleome chelidonii*	*	*		*	
49	*Cleome viscosa*		*			
50	*Commelina benghalensis*	*	*		*	
51	*Corchorus aestuans*		*			
52	*Corchorus olitorius*		*		*	
53	*Corchorus tridens*		*			
54	*Corchorus trilocularis*	*	*		*	
55	*Crotalaria albida*		*			
56	*Crotalaria angulata*	*	*		*	*
57	*Crotalaria calycina*	*				
58	*Crotalaria evolvuloides*	*	*	*		
59	*Crotalaria retusa*		*			
60	*Crotalaria willdenowiana*			*		
61	*Croton bonplandianus*	*	*			
62	*Cucumis melo ssp. agrestis var. agrestis*		*			
63	*Cuscuta chinensis*			*		
64	*Cuscuta reflexa*		*			
65	*Cyanotis axillaris*		*			
66	*Cyanthillium cinereum*		*			
67	*Cymbopogon caesius*	*	*	*		
68	*Cynodon dactylon*	*	*			
69	*Cyperus cuspidatus*	*				
70	*Cyperus rotundus*		*			
71	*Cyperus sp.*		*			
72	*Dactyloctenium aegyptium*	*	*	*	*	
73	*Dalbergia sissoo*		*			
74	*Dicliptera paniculata*		*			
75	*Digera arvensis*		*			
76	*Digera muricara*	*	*	*	*	
77	*Digitaria bicornis*	*			*	
78	*Digitaria ciliaris*		*			
79	*Eragrostiella bifaria*	*	*			
80	*Eragrostis aspera*	*	*			
81	*Eragrostis ciliaris*		*			
82	*Eragrostis maderaspatana*		*			
83	*Eragrostis tenella*	*	*	*		*
84	*Erigeron bonariensis*	*				
85	*Euphorbia hypericifolia*	*	*	*	*	
86	*Evolvulus alsinoides*	*	*	*	*	*
87	*Dicanthium annulatum*		*			
88	*Hedyotis corymbosa*	*	*			
89	*Heteropogon contortus*	*	*			
90	*Hibiscus micranthus*	*	*			*

91	*Hybanthus enneaspermus*	*			*	
92	*Indigofera linifolia*				*	
93	*Indigofera linnaei*	*	*	*	*	
94	*Ipomoea pes-caprae*	*			*	
95	*Ipomoea pes-tigridis*		*			
96	*Justicia tranquebariensis*	*				
97	*Kyllinga neomoralis*	*	*			
98	*Lantana camera*		*			
99	*Lepidagathis pungens*	*				
100	*Leucas zeylanica*					*
101	*Leucas aspera*	*	*	*	*	
102	*Leucas urticifolia*			*		
103	*Malvastrum coromandalicum*		*			
104	*Melhania incana*	*				
105	*Merremia tridentata*	*	*	*	*	*
106	*Mimosa pudica*		*			
107	*Mollugo nudicaulis*	*	*		*	
108	*Moringa oleifera*	*				
109	*Ocimum americanum*		*	*	*	
110	*Ocimum tenuiflorum*	*	*			
111	*Oldenlandia corymbosa*		*			
112	*Oldenlandia stricta*		*			
113	*Oldenlandia umbellata*	*		*		
114	*Panicum trigonum*			*		
115	*Parthenium hysterophorus*	*	*	*		
116	*Passiflora foetida*			*		
117	*Pavonia odorata*	*	*	*		
118	*Pavonia zeylanica*		*			
119	*Pedalium murex*		*			
120	*Pergularia daemia*	*	*			
121	*Perotis indica*	*	*	*		*
122	*Phyllanthus amarus*		*	*		
123	*Phyllanthus maderaspatensis*	*	*	*	*	
124	*Phyllanthus urinaria*	*				
125	*Phyllanthus virgatus*		*			
126	*Polycarpaea corymbosa*	*	*	*		*
127	*Polygala arvensis*	*	*	*		
128	*Polygala erioptera*		*			
129	*Prosopis juliflora*	*	*			
130	*Pupalia lappacea*		*			
131	*Santalum album*		*			
132	*Sesamum indicum*	*				
133	*Setaria pumila*	*				
134	*Sida acuta*		*			
135	*Sida cordata*	*			*	
136	*Sida cordifolia*		*			
137	*Solanum elaeagnifolium*		*			
138	*Sorghum bicolor*	*				

139	*Spermacoce articularis*	*	*		*	
140	*Spermacoce hispida*	*	*	*	*	*
141	*Spermacoce pusilla*	*	*	*	*	
142	*Sporobolus diander*	*	*			
143	*Striga asiatica*		*			
144	*Striga densiflora*					*
145	*Stylosanthes fruticosa*	*			*	
146	*Tephrosia maxima*		*			
147	*Tephrosia pumila*		*			
148	*Tephrosia purpurea*	*	*	*	*	*
149	*Tephrosia villosa*	*	*		*	
150	*Tinospora cordifolia*		*			
151	*Tragus biflorus*	*	*	*	*	
152	*Tribulus lanuginosus*				*	*
153	*Tribulus terrestris*	*	*			
154	*Trichodesma indicum*	*	*	*	*	
155	*Tridax procumbens*	*	*	*	*	
156	*Tripogon bromoides*		*			
157	*Vachellia leucophloea*	*				
158	*Vernonia cinerea*	*	*		*	
159	*Vetiveria zizanoides*		*			
160	*Vigna trilobata*		*	*	*	
161	*Waltheria indica*	*	*		*	
162	*Wedalia trilobata*		*			
163	*Xanthium strumarium*	*				
164	*Xenostegia tridentata*	*	*	*	*	
165	*Zornia diphylla*					*
166	*Zornia gibbosa*	*	*			
167	*Rhynchosia minima*	*	*	*		
168	*Rhynchosia densiflora*		*			
169	*Aristida adscensionis*		*			

Note : * presence of the species

Appendix 3. Checklist of birds recorded from intensive study plantations of VT Programme

S.No	Common name	Scientific name	Occurrence				
			VT 1	VT 2	VT 3	VT 4	VT 5
1	Ashy-crowned sparrow- lark	*Eremopterix griseus*	*				*
2	Asian paradise Flycatcher	*Terpsiphone paradisi*				*	
3	Asian palm swift	*Cypsiurus balasiensis*		*	*		
4	Asian koel	*Eudynamys scolopaceus*	*	*	*	*	*
5	Ashy prinia	*Prinia socialis*	*	*	*	*	*
6	Bay backed shrike	*Lanius vittatus*	*	*		*	
7	Black drongo	*Dicrurus macrocercus*	*	*	*	*	*
8	Black- headed munia	*Lonchura atricapilla*		*			
9	Black kite	*Milvus migrans*	*		*	*	*
10	Blue rock pigeon	*Columba livia*	*	*		*	
11	Barn swallow	*Hirundo rustica*	*	*			*
12	Brahminy myna	*Sturnia pagodarum*	*	*			
13	Brown shrike	*Lanius cristatus*		*	*		
14	Blyth's reed warbler	*Acrocephalus umetorum*	*	*		*	
15	Black- shouldered kite	*Elanus axillaris*		*		*	
16	Blue- tailed bee-eater	*Merops philippinus*		*			
17	Chestnut- headed bee- eater	*Merops leschenaulti*		*			
18	Common hawk-Cuckoo	*Hierococcyx varius*	*	*		*	
19	Common hoopoe	*Upupa epops*	*		*		
20	Common iora	*Aegithina tiphia*	*			*	
21	Common myna	*Acridotheres tristis*	*	*	*	*	*
22	Copper smith barbet	*Psilopogon haemacephalus*				*	
23	Common tailor bird	*Orthotomus sutorius*	*	*	*	*	*
24	Common wood shrike	*Tephrodornis pondicerianus*	*				
25	Chestnut-shouldered petronia	*Gymnoris xanthocollis*		*			
26	Cattle egret	*Bubulcus ibis*	*	*			*
27	Eurasian collared dove	*Streptopelia decaocto*	*	*		*	*
28	Green bee-eater	*Merops orientalis*	*	*	*	*	*
29	Greater coucal	*Centropus sinensis*	*	*	*		*
30	Grey francolin	*Francolinus pondicerianus*	*	*	*	*	
31	Greenish leaf warbler	*Phylloscopus trochiloidea*	*	*	*		*
32	Green warbler	*Phylloscopus nitidus*	*	*	*	*	

33	House crow	*Corvus splendens*	*	*	*	*	*
34	House sparrow	*Passer domesticus*		*		*	
35	Indian peafowl	*Pavo cristatus*	*	*	*	*	*
36	Indian pond heron	*Ardeola grayii*		*			*
37	Indian robin	*Copsychus fulicatus*		*	*	*	
38	Indian roller	*Coracias benghalensis*	*	*	*	*	
39	Indian spot- billed duck	*Anas poecilorhyncha*		*			
40	Jacobin cuckoo	*Clamator jacobinus*		*			
41	Jungle bush Quail	*Perdicula asiatica*	*				*
42	Jungle crow	*Corvus macrorhynchos*	*	*	*		*
43	Jerdon's bush lark	*Mirafra affinis*	*	*		*	
44	Large grey babbler	*Turdoides malcolmi*	*	*	*	*	*
45	Laughing dove	*Spilopelia senegalensis*		*	*	*	
46	Lesser golden - back woodpecker	*Dinopium benghalense*	*	*			
47	Little cormorant	*Microcarbo niger*		*	*		
48	Little egret	*Egretta garzetta*		*	*		*
49	Loten’s sunbird	*Cinnyris lotenius*		*			
50	Long -tailed shrike	*Lanius schach*				*	*
51	Orange minivet	*Pericrocotus flammeus*				*	
52	Oriental sky lark	*Alauda gulgula*	*	*	*	*	
53	Pied bush chat	*Saxicola caprata*	*	*	*		*
54	Pale- billed flower pecker	*Dicaeum erythrorhynchos*	*				*
55	Paddy field pipit	*Anthus rufulus*		*			*
56	Plain prinia	*Prinia inornata*	*	*	*	*	
57	Purple-rumped Sunbird	*Leptocoma zeylonica*	*	*		*	*
58	Purple sunbird	*Cinnyris asiaticus*	*	*	*	*	*
59	Rufus tree pie	*Dendrocitta vagabunda*	*	*	*	*	
60	Rose- ringed parakeet	*Psittacula krameri*	*	*	*	*	
61	Red- rumped swallow	*Cecropis daurica*		*	*		
62	Red- vented bulbul	*Pycnonotus cafer*	*	*	*	*	*
63	Red- whiskered bulbul	*Pycnonotus jocosus*		*			
64	Red-wattled lapwing	*Vanellus indicus*		*	*		*
65	Scaly-breasted munia	*Lonchura punctulata*	*	*		*	
66	Shikra	*Accipiter badius*		*	*		
67	Silver bill	*Euodice malabarica*	*	*			
68	Spotted dove	*Spilopelia chinensis*	*	*	*	*	
69	Spotted owlet	*Athene brama*		*	*		
70	Tawny- bellied	*Dumetia hyperythra*		*			

	Babbler						
71	Indian Thick - knee	*Burhinus indicus*			*		
72	White - browed bulbul	*Pycnonotus luteolus*		*			
73	White -breasted Waterhen	*Amaurornis phoenicurus*		*			
74	White - browed wagtail	*Motacilla maderaspatensis*		*			
75	White- rumped Shama	*Copsychus malabaricus*		*			
76	White- throated kingfisher	*Halcyon smyrnensis*	*	*	*		
77	Yellow- billed Babbler	*Argya affinis*	*	*	*	*	*
78	Yellow - wattled lapwing	*Vanellus malabaricus*			*		*
79	Zitting cisticola	*Cisticola juncidis*				*	

Note : * presence of the species

Bamboo Plantation with Tirupur City Commissioner of Police Mr.Karthikeyan IPS

Appendix 4. Checklist of butterflies recorded from intensive study plantations of VT programme

S.No	Common name	Scientific name	Occurrence				
			VT 1	VT 2	VT 3	VT 4	VT 5
1	African babul blue	*Azanus jesous*	*				
2	Angled castor	*Ariadne ariadne*	*				
3	African marbled skipper	*Gomalia elma*	*	*	*	*	
4	Blue mormon	*Papilio polymnestor*			*		
5	Blue pansy	*Junonia orithiya*	*	*	*	*	*
6	Blue tiger	*Tirumala limniace*	*	*	*	*	
7	Common Four-ring	*Ypthima huebneri*		*		*	
8	Common Five-ring	*Ypthima baldus*		*			
9	Chestnut bob	*Iambrix salsala*		*	*		
10	Chocolate pansy	*Junonia iphita*	*	*	*	*	*
11	Common banded awl	*Hasora chromus*	*		*		
12	Common bush brown	*Mycalesis perseus*	*	*	*		*
13	Common cerulean	*Jamides celeno*	*	*			
14	Common crow	*Euploea core*	*	*	*	*	
15	Common castor	*Ariadne merione*	*	*	*		
16	Common dartlet	*Oriens goloides*		*			
17	Common evening brown	*Melanitis leda*			*		
18	Common emigrant	*Catopsilia pomona*	*	*	*	*	*
19	Common gull	*Cepora nerissa*		*	*	*	
20	Common grass yellow	*Eurema hecabe*	*	*	*	*	*
21	Common jezebel	*Delias eucharis*	*	*	*	*	*
22	Common mormon	*Papilio polymnestor*	*	*	*		
23	Common pierrot	*Castalius rosimon*	*	*			
24	Common rose	*Atrophaneura aristolochiae*	*	*	*	*	*
25	Common silverline	*Spindasis vulcanus*			*		
26	Common three ring	*Ypthima asterope*	*				
27	Common wanderer	*Pareronia valeria*	*	*	*		
28	Crimson rose	*Atrophaneura hector*	*	*	*		*
29	Crimson tip	*Colotis danae*	*		*		
30	Dark blue tiger	*Tirumala septentrionis*	*				
31	Danaid egg fly	*Hypolimnas misippus*	*	*	*	*	*
32	Dark grass blue	*Zizeeria karsandra*	*				*
33	Forget -me -not	*Catochrysops strabo*	*	*	*		
34	Great eggfly	*Hypolimnas bolina*		*			
35	Great orange tip	*Hebomoia glaucippe*		*			
36	Gram blue	*Euchrysops cnejus*		*	*	*	
37	Grass jewel	*Freyeria trochylus*	*	*	*	*	*
38	Indian skipper	*Spialia galba*	*		*		*
39	Joker	*Byblia ilithyia*	*	*	*	*	

40	Lime blue	*Chilades lajus*	*	*	*		
41	Lime butterfly	*Papilio demoleus*		*	*		
42	Lemon pansy	*Junonia lemonias*	*	*	*		
43	Mottled emigrant	*Catopsilia pyranthe*	*	*	*	*	
44	Oriental grass Jewell	*Freyeria putli*		*			
45	Pointed ciliate blue	*Anthene lycaenina*		*	*		
46	Pea blue	*Lampides boeticus*		*	*		
47	Pale grass blue	*Pseudozizeeria maha*	*		*		
48	Plains cupid	*Chilades pandava*		*			
49	Plain tiger	*Danaus chrysippus*	*	*	*	*	
50	Plain orange tip	*Colotis eucharis*	*		*		
51	Psyche	*Leptosia nina*	*	*	*		
52	Small grass yellow	*Eurema brigitta*					*
53	Slate flash	*Rapala manea*			*		
54	Small orange tip	*Colotis etrida*	*		*		
55	Small salmon arab	*Colotis amata*	*		*		
56	Striped tiger	*Danaus genutia*			*		
57	Tiny grass blue	*Zizula hylax*	*		*	*	
58	Three spot grass yellow	*Eurema blanda*			*	*	
59	Tawny coster	*Acraea violae*	*	*	*	*	
60	White four ring	*Ypthima ceylonica*	*	*	*		
61	White orange tip	*Ixias marianne*	*	*	*		
62	Water snowflat	*Tagiades litigiosa*		*			
63	Yellow pansy	*Junonia hierta*	*	*	*	*	
64	Yellow orange tip	*Ixias pyrene*	*	*			
65	Zebra blue	*Leptotes plinius*	*	*			

Note : * presence of the species

Appendix 5. Checklist of butterflies and their host plants recorded from intensive study plantations of VT programme

S.No	Common name	Family	Host plant
1	African babul blue	Lycaenidae	*Acacia leucoplia*
2	Angled castor	Nymphalidae	*Riccinus communis*
3	African marbled skipper	Hesperiidea	*Abutilon indicum*
4	Blue mormon	Papilionidae	*Murraya koiengii*
5	Blue pansy	Nymphalidae	*Mimosa pudica*
6	Blue tiger	Nymphalidae	*Calotropis procera*
7	Common Four-ring	Nymphalidae	*Cynadon dactylon*
8	Common Five-ring	Nymphalidae	*Cynadon dactylon*
9	Chestnut bob	Hesperiidea	*Aristida hystrix*
10	Chocolate pansy	Nymphalidae	*Barleria cristata*
11	Common banded awl	Hesperiidea	*Pongamia pinnata*
12	Common bush brown	Nymphalidae	*Chrysopogon sp.*
13	Common cerulean	Lycaenidae	*Pongamia pinnata*
14	Common crow	Nymphalidae	*Nerium olenader*
15	Common castor	Nymphalidae	*Riccinus communis*
16	Common dartlet	Hesperiidea	*Poa annua*
17	Common evening brown	Nymphalidae	*Panicum trigonum*
18	Common emigrant	Pieridae	*Cassia auriculata*
19	Common gull	Pieridae	*Barleria cristata*
20	Common grass yellow	Pieridae	*Acacia leucoplia*
21	Common jezebel	Pieridae	*Taxus baccata*
22	Common mormon	Papilionidae	*Citrus sp.*
23	Common pierrot	Lycaenidae	*Bryophyllun delagonse*
24	Common rose	Papilionidae	*Aristolochea bracteata*
25	Common silverline	Lycaenidae	*Barleria prionitis*
26	Common three ring	Nymphalidae	*Chloris barbata*
27	Common wanderer	Pieridae	*Capparis zeylanica*
28	Crimson rose	Papilionidae	*Aristolochea bracteata*
29	Crimson tip	Pieridae	*Cadaba fruticosa*
30	Dark blue tiger	Nymphalidae	*Calotropis procera*
31	Danaid egg fly	Nymphalidae	*Hibiscus micranthus*
32	Dark grass blue	Lycaenidae	*Alysicarpus vaginalis*
33	Forget -me -not	Lycaenidae	*Pongamia pinnata*
34	Great eggfly	Nymphalidae	*Hibiscus micranthus*
35	Great orange tip	Pieridae	*Capparis divericata*
36	Gram blue	Lycaenidae	*Indigogfera*
37	Grass jewel	Lycaenidae	*Acalypha indica*
38	Indian skipper	Hesperiidea	*Sida cordata*
39	Joker	Nymphalidae	*Passiflora foetida*

40	Lime blue	Lycaenidae	*Murraya Koiengii*
41	Lime butterfly	Papilionidae	*Murraya Koiengii*
42	Lemon pansy	Nymphalidae	*Barleria prionitis*
43	Mottled emigrant	Pieridae	*Asclepias curassavica*
44	Oriental grass jewel	Lycaenidae	*Achyranthes aspera*
45	Pointed ciliate blue	Lycaenidae	*Cycas sp.*
46	Pea blue	Lycaenidae	*Crotalaria retusa*
47	Pale grass blue	Lycaenidae	*Amaranthus viridis*
48	Plains cupid	Lycaenidae	*Cycas sp.*
49	Plain tiger	Nymphalidae	*Calotropis procera*
50	Plain orange tip	Pieridae	*Capparis divericata*
51	Psyche	Lycaenidae	*Capparis spinosa*
52	Small grass yellow	Pieridae	*Cassia auriculata*
53	Slate flash	Lycaenidae	*Lantana indica*
54	Small orange tip	Pieridae	*Cappris spinosa*
55	Small salmon arab	Pieridae	*Toddalia asiatica*
56	Striped tiger	Nymphalidae	*Asclepias curassavica*
57	Tiny grass blue	Lycaenidae	*Alysicarpus vaginalis*
58	Three spot grass yellow	Pieridae	*Cassia auriculata*
59	Tawny coster	Nymphalidae	*Passiflora foetida*
60	White four ring	Nymphalidae	*Setaria barbata*
61	White orange tip	Pieridae	*Cadaba fruticosa*
62	Water snowflat	Hesperiidea	*Dioscorea alata*
63	Yellow pansy	Nymphalidae	*Hygrophila auriculata*
64	Yellow orange tip	Pieridae	*Capparis zeylanica*
65	Zebra blue	Lycaenidae	*Cassia auriculata*

Appendix 6. Checklist of spiders recorded from intensive study plantations of VT programme

S. No	Scientific name	Occurrence				
		VT1	VT2	VT3	VT4	VT5
1	*Achaearanea mundula*		*			
2	*Argiope anasuja*	*	*	*		*
3	*Argyrodes sp 1*		*			
4	*Araneus mitificus*		*			
5	*Carrhotus viduus*		*	*		
6	*Cheriracanthium melanostomum*	*	*			
7	*Cyrtophora sp. 1*	*	*			
8	*Cyrtophora sp. 2*	*	*	*		*
9	*Cyclosa sp 1*		*			
10	*Cyclosa sp2*	*	*	*		
11	*Drassodes sp 1*	*		*		*
12	*Eriovixia sp 1*	*		*		
13	*Gasteracantha geminata*			*		
14	*Heteropoda sp 1*		*			
15	*Hippasa agelenoides*	*	*	*		
16	*Hyllus semicupreus*				*	
17	*Leucauge docorata*	*	*	*	*	
18	*Lycosa mackenziei*	*	*	*		
19	*Misumena sp 1*			*		
20	*Myrmarachne plataleoides*	*				
21	*Myrmarachne prava*		*	*		
22	*Neoscona sp 1*		*	*		
23	*Neoscona sp 2*		*	*	*	
24	*Olios sp*		*			
25	*Olios milleti*		*			
26	*Oxyopes heterothalmus*		*	*		
27	*Oxyopes javanus*	*	*			
28	*Oxyopes sunandae*	*	*			
29	*Peucetia sp 1*		*			
30	*Peucetia viridana*		*			
31	*Pisanura sp*		*		*	
32	*Phintella verisicolor*		*	*		
33	*Phintella Vittata*		*			
34	*Plexippus paykulli*		*	*		
35	*Phycosoma martinae*	*	*			
36	*Stenaelurillus sp*		*	*		
37	*Stegodyphus sarasinorum*		*			*
38	*Telamonia dimidiata*		*	*		
39	*Thelacantha brevispina*	*	*			
40	*Thyene imperialis*		*			
41	*Thomisus lobosus*		*			*

Appendix 7. Checklist of dragonflies recorded from intensive study plantations of VT Programme

S no	Species name	Scientific name	VT1	VT2	VT3	VT4	VT5
1	Slender blue skimmer	*Orthetrum luzonicum*	*			*	*
2	Crimson-tailed marsh hawk	*Orthetrum pruinosum*	*			*	
3	Brown-backed red marsh hawk	*Orthetrum chrysis*					*
4	Green marsh hawk	*Orthetrum sabina*	*			*	*
5	Crimson marsh glider	*Trithemis aurora*	*				
6	Black stream glider	*Trithemis festiva*	*		*		*
7	Coromandel marsh dart	*Ceriagrion coromandelianum*	*				
8	Ruddy marsh skimmer	*Crocothemis servilia*	*		*	*	
9	Ditch jewel	*Brachythemis contaminata*	*	*	*		
10	Yellow-tailed ashy skimmer	*Potamarcha congener*	*			*	
11	Wandering glider	*Pantala flavescens*	*	*	*	*	*

Note : * presence of the species

Appendix 8. Checklist of mammals recorded from intensive study plantations of VT Programme

S. no	Species name	Scientific name	VT1	VT2	VT3	VT4	VT5
1	Indian mole-rat	*Bandicota bengalensis*	*		*		
2	House rat	*Rattus rattus*	*	*			*
3	Three-striped palm squirrel	*Funambulus palmarum*	*	*	*	*	*
4	Black-naped hare	*Lepus nigricollis*	*	*			*
5	Bonnet macaque	*Macaca radiata*			*		

Note : * presence of the species

Appendix 9. Checklist of reptiles recorded from intensive study plantations of VT Programme

S No	Species name	Scientific name	VT1	VT2	VT3	VT4	VT5
1	Bark gecko	*Hemidactylus leschenaultii*		*			
2	Termite hill gecko	*Hemidactylus triedrus*	*			*	
3	Pnemaspis sp				*		
4	Common garden lizard	*Calotis versicolor*	*	*	*	*	*
5	Monitor lizard	*Varanus bengalensis*	*	*	*		
6	Rat snake	*Ptyas mucosa*	*	*	*	*	*
7	Spectacled cobra	*Naja naja*	*	*	*	*	*
8	Russell's viper	*Daboia russelii*		*			*
9	Common kukri	*Oligodon arnensis*	*				
10	Green vine snake	*Ahaetulla nasuta*	*		*		
11	Fejervarya sp		*				
12	Skittering frog	*Euphlyctis cyanophlyctis*	*	*			
13	Asian common Toad	*Duttaphrynus melanostictus*					

Note : * presence of the species

Appendix 10. Checklist of tree species recommended for further planting in VT Programme

S. No	Tree Species	Economic value	Fruit Bearing	Shade Tree
1	*Ailanthus excelsa*	*	-	*
2	*Ailanthus trispicata*	*	-	-
3	*Adina cordifolia*	*	-	-
4	*Aegle marmelos*	*	*	*
5	*Albizia lebbeck*	-	-	*
6	*Azadirachta indica*	*	*	*
7	*Bambusa bamboo*	*	-	*
8	*Bauhinia purpurea*	-	-	*
9	*Bauhinia racemosa*	-	-	*
10	*Calophyllum pinnatum*	*	*	*
11	*Cassia fistula*	*	-	*
12	*Cassia siamia*	-	-	*
13	*Casuarina equsetifolia*	*	-	*
14	*Ceiba pentandra*	*	-	*
15	*Dalbergia latifolia*	*	-	*
16	*Dalbergia sissoo*	*	-	*
17	*Delonix regia*	-	-	*
18	*Dolichandrone atrovirens*	-	-	*
19	*Ficus amplicima*	*	*	-
20	*Ficus auriculata*	*	*	*
21	*Ficus racemosa*	*	*	*
22	*Ficus religiosa*	*	*	*
23	*Gliciridium sepium*	-	-	*
24	*Holoptelia integrifolia*	*	-	*
25	*Leucaena leucocephala*	*	-	*
26	*Madhuca longifolia*	*	*	*
27	*Melia dubia*	*	*	*
28	*Mimusops elengi*	*	*	*
29	*Muntingia calabura*	-	*	*
30	*Peltophorum pterocarpum*	*	-	*
31	*Pithecellobium dulce*	*	*	-
32	*Pongamia pinnata*	*	*	*
33	*Pterocarpus santalinus*	*	-	-
34	*Pterocarpus marsupium*	*	-	-
35	*Samanea saman*	-	-	*
36	*Sandalum album*	*	*	*
37	*Sapindus emarginatus*	*	*	*
38	*Simarouba glauca*	*	*	*
39	*Spathodea campanulata*	-	-	*

40	*Swietenia mahagoni*	*	-	*
41	*Syzygium cumini*	*	*	*
42	*Tamarindus indica*	*	-	*
43	*Tectona grandis*	*	-	-
44	*Terminalia arjuna*	*	-	*
45	*Terminalia bellarica*	*	*	-
46	*Terminalia catappa*	*	-	*
47	*Thespesia populnea*	*	*	*
48	*Wrightia tinctoria*	-	-	*
49	*Melia azedarach*	*	*	*
50	*Mangifera indica*	*	*	*
51	*Morus alba*	*	*	*
52	*Litchi chinensis*	*	*	*
53	*Ziziphus jujuba*	*	*	*
54	*Gmelina arborea*	*	*	*
55	*Neolamarckia cadamba*	*	-	*
56	*Annona squamosa*	*	*	*
57	*Annona muricata*	*	*	*
58	*Psidium guajava*	*	*	*
59	*Citrus medica*	*	*	*
60	*Kigelia pinnata*	*	-	*
61	*Putranjiva roxburghii*	*	-	*
62	*Phyllanthus emblica*	*	*	*
63	*Moringa oleifera*	*	*	*
64	*Terminalia chebula*	*	*	*
65	*Limonia acidissima*	*	*	*
66	*Citrus limon*	*	*	*
67	*Shorea Robusta*	*	*	*
68	*Magnolia champaca*	*	*	*
69	*Cordia sebestena*	-	-	*
70	*Millingtonia hortensis*	*	-	*

Note : * tree type