# STUDY ON ALLERGENIC POLLEN PLANTS: DISTRIBUTION IN FIVE UNITS OF COCHIN CORPORATION, ERNAKULAM DISTRICT, KERALA

Dissertation submitted in partial fulfillment of the requirements

For the award of the degree of **Master of Science** in

**BOTANY**

**DHANYA. S**

**REGISTER NUMBER : AM22BOT008**


DEPARTMENT OF BOTANY AND CENTRE FOR RESEARCH

ST.TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

2022-24

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## CERTIFICATE

This is to certify that the dissertation entitled "STUDY ON ALLERGENIC POLLEN DISTRIBUTION IN FIVE UNITS OF ELOOR MUNICIPALITY, ERNAKULAM DISTRICT, KERALA: Insights from Diversity Assessment, Plant Abundance, Pollen Morphology, and Field Observations" is an authentic record of work carried out by **DHANYA. S** under my supervision and guidance in the partial fulfillment of the requirement of the M. Sc. Degree of Mahatma Gandhi University, Kottayam. I, further certify that no part of the work embodied in this dissertation work has been submitted for the award of any other degree or diploma.

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Date : 20-03-24

External Examiners
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2. Dr. Sagi Abraham 3/5/24.

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I hereby declare that the dissertation entitled "A STUDY ON ALLERGENIC POLLEN PLANTS: DISTRIBUTION IN FIVE UNITS OF COCHIN ELOOR MUNICIPALITY, ERNAKULAM DISTRICT, KERALA" submitted to Mahatma Gandhi University, Kottayam in partial fulfilment of the requirements for the award of the degree of Master of Science is a bonafide record of the original project work done by me under the supervision and guidance of Dr. Arya P. Mohan, in Department of Botany, St. Teresa's College (Autonomous), Ernakulam and that has not previously formed the basis for the award of any degree, diploma, associate ship, fellowship or other similar title or recognition to any candidate of the university

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Dhanya. S

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# ABSTRACT

This study investigates the dynamics of pollen allergies in urban environments, with an emphasis on Eloor Municipality, which is noted for its heavy industrialization and high levels of air pollution. The study attempts to understand the incidence of pollen allergies and its relationship with climatic patterns and plant diversity by combining assessments of plant and pollen morphology, weather data, and public survey results. The data show a considerable increase in temperatures prior to March, as well as a drop in humidity, which could potentially intensify allergy reactions throughout the summer months. High temperatures and air pollution have been found as major contributors to increased pollen generation and dispersion, particularly among wind-pollinated plants. Pollen allergy symptoms are common among residents, as evidenced by survey data.


## 1.0 INTRODUCTION

## 1.1 BACKGROUND

Scientists have extensively studied how plants and climate are connected, particularly in understanding how environmental changes affect ecosystems. Pollen calendars, which record the time- based dispersal of pollen in particular geographical regions, have become essential tools in this effort.

Pollen allergy is regarded as a major public health issue that causes morbidity and so reduces a patient's quality of life. According to the existing literature, climate change and air pollutants may modify pollen number, morphology, season, allergen concentration, and distribution pattern (Ravindra et al., 2022). The rise of urbanization and the impacts of climate change contribute to an increased prevalence of respiratory ailments such as allergic rhinitis and asthma, affecting both human populations and the broader biosphere (Singh et al., 2021).

Pollen is an important reproductive agent for thousands of plant species, ranging from Gymnosperms to Angiosperms, but it also contributes significantly to the overall bio aerosol mass (Sénéchal et al., 2015). Pollen calendars are valuable tools for monitoring pollen levels and determining allergy concerns in specific places. Pollen grains, which are formed during plant reproduction, are typically spherical or elliptical in shape and range in size from 0.01 mm to 0.1 mm. Their strong outer walls are resistant to harm and may be recognized by their shape, size, and distinctive embellishments. Identification is usually done at the genus or family level, although it can sometimes be done down to the species level (D'Amato et al., 2017).

Understanding trends in airborne pollen allergens is crucial due to the significant global impact of pollen-related respiratory illnesses. Aero palynology has developed as a complex field requiring multidisciplinary knowledge of pollen allergen molecular identity, the types of allergen-carrying particles (such as pollen grains, sub-particles, and small airborne particles), and their distribution sources. To assess the health risks posed by urban vegetation and airborne pollen levels to allergic individuals, it's essential to develop efficient monitoring technologies and reliable allergy risk indices (Suanno et al., 2021).

Exposure to green space may reduce the intensity of tree pollen allergy symptoms, but only when allergenic trees are sparsely distributed. Air pollution lead to worsening allergy symptoms. Spatio temporal tracking enables more accurate exposure assessment (Stas et al., 2021). Pollen grains are transported from the floral anther to the recipient stigma by wind or insects, which is the most important reproductive event in higher plants. Wind pollination relies on many duplicate units to ensure success and prevent health issues such as asthma, rhinitis, and atopic dermatitis (Singh et al., 2014). Analyse the extremely complex nature of indoor and outdoor allergens relevant to the Indian population. Given the country's broad cross-sectional geographical area and varying climatic circumstances between north-south and east-west, they detected

commonalities and differences in aero allergens and highlighted cross-reactivity between pollens, dust mites, and fungus (Krishna et al., 2023).

This study focuses on five specific wards in the Eloor Municipality, located in Ernakulam district, Kerala, each having distinct ecological features and human influences. Eloor Municipality, located in the southwestern state of Kerala, India, is a small-scale example of diverse plant and animal life in an urban environment. The studmpasses the period from December to March which late north east monsoon and premonsoon period.

## 1.2 HISTORY

Grass pollen exposure is a risk factor for pediatric asthma hospitalizations. However, the short-term impact on lung function, particularly among people with co-morbid allergy diseases, has received less attention. Prior to high-grass pollen days, a proactive strategy to managing sensitive youngsters, particularly those with food allergies, is necessary (Idrose et al., 2022).

Pollen-sensitive persons with AR may experience oral symptoms of pollen food syndrome, such as itching mouth and throat after consuming the food (Bousquet et al., 2020). The Melbourne Air Pollen Children and Adolescent Health (MAPCAH) study in Melbourne, Australia, discovered a connection between aero allergen exposure and peak asthma symptoms over two grass pollen seasons. Two peak periods were observed, influenced by atopy, gender, and pollen exposure two days prior. Same-day fungal spores, particularly Alternaria, were very important. For boys, grass at lag 2 increased probability by 1.03 (95% CI 1.01, 1.05) per spore/m3, while same-day Alternaria rose by 1.02 (1.00, 1.04). The study emphasizes the importance of better information for families and caregivers about the increased risk of asthma attacks before pollen seasons(Batra et al., 2022). Pollen grains are one of the most common allergens for allergic persons. Pollen allergy is becoming a public health concern due to its increased prevalence and the high costs associated with poor job fitness, sick leave, consulting physicians, and medications. In European Community countries, between 8% and 35% of young people develop IgE blood antibodies against the most common grass pollen allergens. In addition to grass, the main pollens involved in rhinitis and asthma are birch in northern regions and ragweed in east-central Europe.

(D'Amato et al., 2017). The most often tested allergic disorder was asthma (69.8%), followed by allergic rhinitis (59.7%). A total of 24.46% of patients had both bronchial asthma and allergic rhinitis. 33.81% of the study population suffered from combined allergy illnesses. Allergic conjunctivitis was the least common allergic disease (Kunoor et al., 2017).

## 1.3 POLLEN GRAINS

The pollen wall is typically divided into an inner intine and an outer sculptured exine. The inner layer is heavy in cellulose, while the outside wall is formed of sporo pollenin, a thick, robust biopolymer that allows the pollen to tolerate extremely high temperatures (up to 3000°C), strong acids, and harmful radiation (Singh et al., 2021). Land plants are frequently diploids, alternating between sporophyte and gametophyte stages during their life cycle. Gametophytes are smaller than sporophytes and grow inside structures on the sporophyte. Pollen grains are male gametophytes that develop in anthers, the male parts of flowers. Meiosis occurs in the anthers. Pollen mother cells undergo meiosis.

In diploid plants, each haploid meiosis product (unicellular microspore) divides asymmetrically to form two haploid cells (bicellular pollen grains). The smallest of these two cells is successfully absorbed into the cytoplasm of the larger cells. The smaller cell splits again, producing two haploid sperm cells(McCormick et al., 2013).

Weeds, bushes, grasses, and trees all generate pollen, a fine powder-like particle. Wind is one of the most important ways of pollen dispersal. Plants pollinated by animals are more numerous. However, in terms of allergies, humans are more susceptible to pollen transported by the wind. Flowers with vividly colored petals and sugary smells (to attract insects) are often less allergenic, but pollens from dull shades and small flowers with no discernable aroma (mainly transported by the wind) are more likely to cause hay fever or allergies. (Mansouritorghabeh et al., 2019).

Pollen grains are produced and distributed as part of the plant's reproductive cycle. They are usually round or elliptical in shape, with dimensions ranging from 0.01 mm to 0.1 mm. The exterior walls are extremely resistant to chemical and physical attack, and they are ornamented and perforated in a number of ways. Pollen grains are found in a variety of sediment types and can be identified by their shape, size, ornamentation, and perforation patterns. Identification is usually done at the genus or family level, although in some situations, it may be possible to get down to the species level. (D'Amato et al., 2017).

The characteristics of ripe pollen, including morphology, cytology, and physiology, are analyzed and compared both individually and in relation to the female counterpart and environmental factors. These include the number, shape, size, and cell structure of pollen grains, dispersal unit types, stratification, furrows, coloration, and other aperture types, as well as water content and mature pollen reserves. These traits can be interrelated, connected to the female counterpart, or influenced by the species' environment (Pacini et al., 2020). Anemophilous plants are the primary source of pollen allergies. Eloor Municipality has a wealth of anemophilous herbs and trees, which are used as primary research materials. Poaceae and Cyperaceae are more frequent herb families. Palmae are typically seen on Aracaceae trees.

## 1.4 POLLEN ALLERGY

Higher pollen concentrations and a longer pollen season may worsen symptoms. Climate change (66%) was the primary driver of our model estimates, although actual trends in the spread of this invasive plant species also played a role (Lake et al., 2017). Understanding airborne pollen allergen trends is crucial due to the significant impact of pollen-related respiratory illnesses globally. Aero palynology has become a complex field requiring multidisciplinary knowledge of pollen allergen molecular identity, the nature of allergen-bearing particles, and their sources. To assess the health risks posed by urban vegetation and pollen concentrations, it's essential to develop efficient monitoring technologies and reliable allergy risk indices (Suanno et al., 2021). Climate change has a substantial impact on the development of asthma and allergic respiratory problems, as well as pollen and mold production, all of which can cause allergy symptoms. Flowering and pollination in cities occur 2-4 days earlier than in rural areas.13 In rural areas, exposure to allergens such as farm dust, trees, and grass might vary by region (Kunoor et al., 2017). More than 300 million individuals suffer from allergies, which have an impact on their socioeconomic situation. Pollen grains are one of the main causes. Several aero biological studies have been conducted worldwide to measure the concentration and seasonality of pollen grains. For therapeutic purposes, it is critical to understand the pollen season and atmospheric pollen load (Verma et al., 2014).

## 1.5 POLLEN CALENDARS

Pollen calendars show the temporal patterns of airborne pollen taxa in a certain geographic area. They provide conveniently accessible visual information about various airborne pollen taxa present throughout the year, as well as their seasonality in a single image (Ravindra et al., 2021). Pollen calendars are one of the most accessible ways to educate allergy sufferers and medical professionals about the average prevalence of allergenic pollen throughout the year (Gehrig et al., 2018).

## 1.6 RELEVANCE OF POLLEN STUDY IN ELOOR MUNICIPALITY

Eloor, situated in Ernakulam district, Kerala, is a major industrial zone around 13 km north of Kochi's city centre. It's Kerala's largest industrial area, covering 14.21 sq km between two Periyar River branches, and shares borders with the Kalamassery hub, Aluva, Cheranalloor, and Paravur. Key industries here include FACT, TCC, IREL, HIL, and Indian Aluminium Company. Despite its industrial prominence, Eloor faces significant air pollution, particularly in the early morning when chemical fumes from factories are released. This pollution is believed to contribute to the rising incidence of allergy-related illnesses in the region (Bartra Tomàs et al., 2007).

Eloor uses latitude 10.0492 and longitude 76.3035. The average temperature will range from 23 to 38 degrees Celsius from December to mid-March. When latitude and longitude increase, humidity levels may

decrease. These geographical and climatic circumstances encourage pollen transport by wind. Pollen allergies can also occur easily.

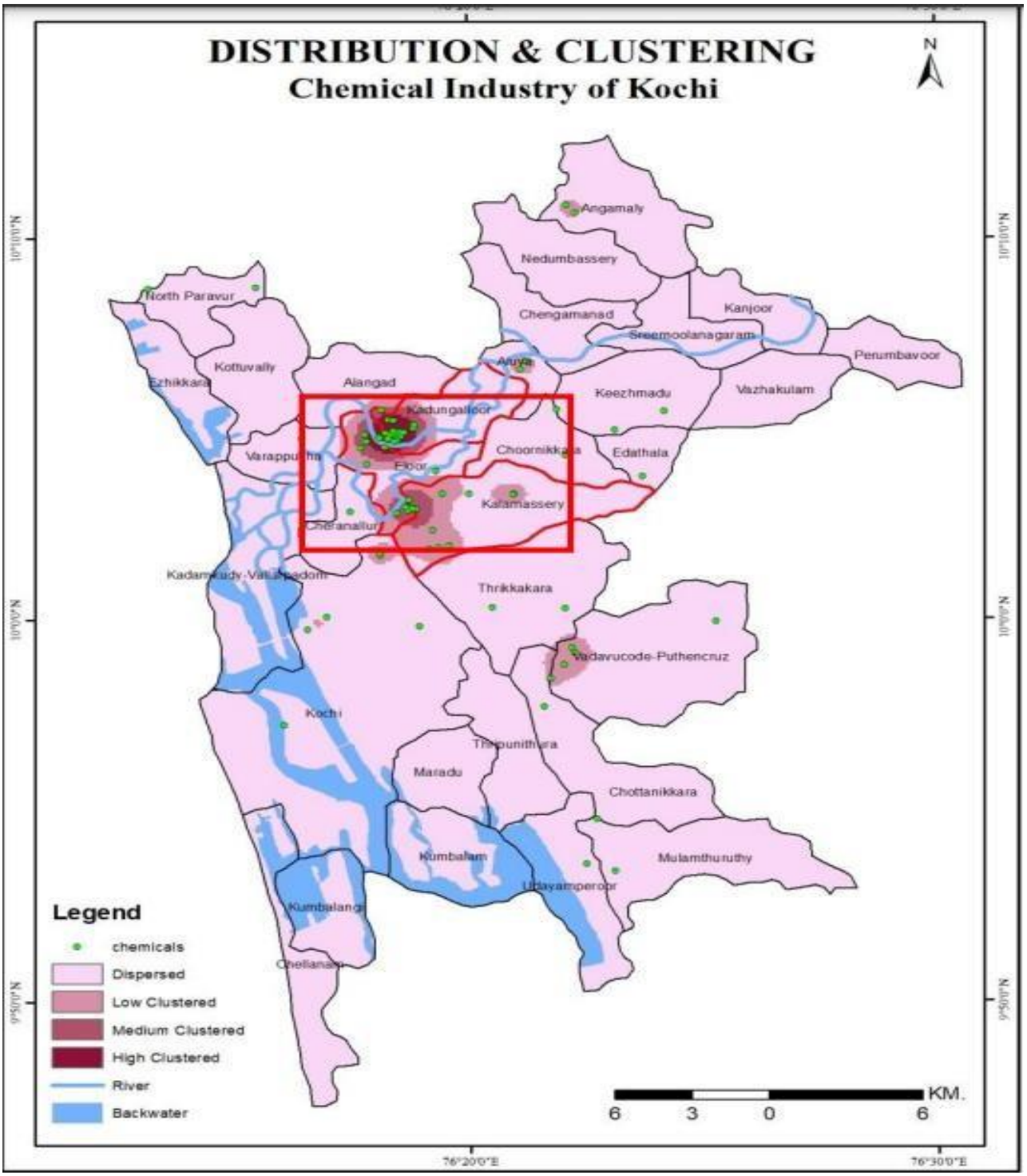


Image1: Industrialisation in Eloor Municipality (Lekshmi et al., 2020.)

## 2.0 OBJECTIVES

- Evaluate allergenic potential of plants in Eloor Municipality, Ernakulam District.
- To investigate their diversity, distribution, and the allergic reactions they induce in the local population.
- To promote awareness in local communities about pollen-related concerns and their implications.
- To comprehend the weather trends and their possible effects on the spread of pollen.
- To determine and describe the pollen structure and allergenic capacity using microscopic methods.

## 3.0 REVIEW OF LITERATURE

The study (Kunoor et al., 2017) at Kochi's tertiary center examined common allergens in suspected atopic patients from central Kerala. From 2012 to 2013, asthma (69.8%) and allergic rhinitis (59.7%) were the most often tested conditions. Houseflies were the most common allergen (53.26%), followed by rice grain dust (47.5%). Insect allergies were detected in abundance, with prawns being the most common food allergen. Regional differences in allergy patterns and allergen types were identified. The study of Lo et al., 2017It displays important pollen taxa and season data, emphasizing earlier and longer pollen seasons at lower latitudes.

More careful monitoring is needed to learn more about pollen allergies. Gehrig explained this in his research work (Gehrig et al., 2018). Pollen calendars provide information on the occurrence of allergic pollen each year.

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Improved monitoring is required for a better knowledge of airborne pollen concentrations. Gehrig explained this in his research work (Gehrig et al., 2018). Pollen calendars provide information on the occurrence of allergic pollen each year. Switzerland's new calendars are consistent with projected levels, show likely occurrence times, and allow for personalization. The method uses 20 years of data from 14 sites to compute 90% quantiles across a 9-day interval, which are then converted to pollen load levels. While adaptable, a 20-year reference offers more consistent dates. These calendars (Katotomichelakis et al., 2015) aid in the identification of pollen seasons for hay fever prophylaxis. Pollen kinds and season lengths vary amongst cities, emphasizing the impact of urban and periurban green spaces on pollen levels. Green areas should be designed to benefit residents while limiting allergens.

In the study of Ravindra Pollen allergies are on the rise, according to a Chandigarh study conducted between 2018 and 2020, which found an average API of 20,000 pollen grains/m3 from 74 different species. Morus alba was the most common source, accounting for 66.74%. Pollen levels were highest between February and April, probably because to extended reproductive cycles and climatic variations. Recognizing major allergenic species can help develop ways to reduce the burden of pollen allergies (Ravindra et al., 2021). The botanist Camacho published (Camacho et al., 2020) that an aerobiological investigation in Portugal revealed a Mediterranean-type pollen spectrum, with Poaceae, Quercus spp., Urticaceae, and Cupressaceae being common. Although these pollen types are important for allergies, Ambrosia artemisiifolia L. is rarely seen in Portugal's pollen composition.

The review (Ravindra et al., 2021) looks at the relationship between airborne pollen and COVID-19 transmission. Some research suggests a link, and people with allergic rhinitis and asthma may have some immunity. More research is needed to better understand pollen's function and plan for future epidemics. A study conducted in Kerala (RAJ et al., 2018) demonstrates that: The study examined skin test data from 1000 individuals at a Respiratory Allergy Clinic in Thiruvananthapuram to determine how pollen allergens affect asthma and allergic rhinitis. Males made up 45.87% of the participants aged 10-49. Cocos nucifera pollen exhibited the highest sensitivity. Allergic reactions were impacted more by family history than by age. Specific pollen kinds in a given area have a major impact on allergies, providing valuable insights for diagnosis and management.

According to Barnes et al. (2018), greater carbon dioxide and temperatures promote allergic plant growth and pollen production, causing allergens to spread to new locations. Stinging insects are heading north. Hurricanes and other climate phenomena raise wet house concerns. Elevated ozone and pollution levels in cities increase pollen potency, and wildfires exacerbate respiratory ailments. According to Calderón-

Ezquerro, pollen, a major airborne allergen, has a big impact on the growing global allergy population. Key allergenic pollen types were most common from December to March, with others present throughout the year. Pollen concentrations varied throughout the day, peaking in the afternoon. Higher temperatures increased pollen levels, whereas increasing rainfall and humidity reduced them. In early 2010, unusual winds, possibly linked to El Niño, caused an increase in pollen levels.

The research (Martínez-Bracero et al., 2015) evaluates the prediction capability of pollen calendars for daily concentrations of Ambrosia, Betula, and Poaceae pollen, which is critical for allergy management. Using historical data and a four-year calibration period, the models show increased accuracy with fewer prediction errors and better alignment with pollen curves. Daily resolutions refine the models by incorporating pollen exposure variability, which is crucial for pollen-sensitive individuals.

In study (Wu et al., 2019) of Garcia the Poaceae family, which includes over 12,000 species, is a major source of airborne pollen that causes global allergies. Sensitization rates vary by country. Cross-reactivity between grass pollen and some fruits can cause food allergies. Allergy symptoms may be exacerbated by urban pollution. Climate change alters plant phenology, which influences pollen levels and allergy prevalence (García-Mozo et al., 2017).

In a study conducted in Taiwan, it was discovered that the most common pollen type, Broussonetia papyrifera, has an important role in asthma and allergic rhinitis. Daily pollen level monitoring and skin testing on 30 individuals revealed a 38.4% sensitivity to this pollen. This emphasizes the importance of integrating aeroallergen surveillance with clinical assessments.

The studies (Martínez et al., 2015) Andalusia's eight provincial capitals in southern Spain have pollen calendars based on a 10-year airborne pollen database to help manage hay fever by indicating when pollen season peaks and its severity. These calendars highlight urban landscape differences and underscore the importance of green spaces with non-allergenic plants. (Camacho et al., 2015).

Pollen concentrations in Korea vary both spatially and seasonally, determined by species distribution and environmental circumstances. Pine, oak, and Japanese hop pollen were identified in descending order of concentration. Pollen levels were elevated in the spring and autumn, with oak and Japanese hop perhaps functioning as key allergic triggers during these seasons. Japanese cedar pollen was notably abundant in Jeju, whereas Jeonju, Gwangju, and Busan recorded moderate quantities.
(Shin et al., 2020).

In a study (Oduber et al., 2019) From 1997 to 2016 in León, biogenic aerosols and pollutants were identified as impacting human health. While pollutant levels decreased over this period, Fraxinus pollen levels

increased. Pollen levels and the duration of pollination are influenced by both weather conditions and pollutant concentrations.

A study (Jaakkola et al., 2021) In the Helsinki Metropolitan Area, researchers investigated the relationship between daily pollen counts of alder, birch, mugwort, and grass and mortality rates. Increased alder pollen levels increased overall mortality by 10% and respiratory fatalities by 78%. Increased mugwort pollen levels were connected to a 41% increase in cardiovascular mortality. These findings highlight a significant global public health issue. Delhi is also known to be one of the cities with the greatest pollen allergies (Kumar et al., 2018). In a study conducted in Garki, Abuja, atmospheric pollen and fungal spores were examined over a year. The research identified a prevalence of fungal spores and pollen, with common fungi such as Alternaria, Fusarium, and Cladosporium linked to allergies and skin ailments. The study did not find a notable correlation between these counts and meteorological conditions (Ezike et al., 2016).

Airborne pollen, collected with a spore sampler, was analyzed to determine its particulate matter composition. The particle size ranged from 0.1 to 25.8 μm, with the majority being tiny particles. The key components discovered were Si-rich, Organic-rich, SO-rich, Metals & Oxides, and Cl-rich. Daily fluctuations in these traits coincide with meteorological conditions and PM concentrations, implying that pollen might absorb small particles, potentially enhancing its allergic qualities. (So et al., 2017).

The study (Singh et al., 2017) aimed to correlate pollen counts with new patient visits for allergic rhinitis and asthma at Asthma Bhawan over two years. Using the Burkard 24-hour spore trap, samples were collected, and skin prick tests were conducted. The average annual pollen count was 14,460.5, peaking in March–April and August–October. Grass pollen levels significantly correlated ($r = 0.59$) with new patient visits, while tree and weed pollen did not. Chenopodium album pollen consistently linked with positive skin prick test results.

Understanding airborne pollen changes is critical due to global pollen-related respiratory illness consequences. Aeropalynology investigates pollen allergens and their dispersion. Reliable monitoring techniques are critical for analyzing the health concerns from urban pollen.(Suanno, et al., 2021). According to Schiavoni (Schiavoni et al., 2017), Finding dependable parameters to evaluate respiratory allergy risks from public greens close to pollution sources is vital for public health management and primary prevention. The study(Singh et al., 2017)explored the relationship between pollen levels and new patient visits for asthma and allergic rhinitis at Asthma Bhawan in Jaipur over two years. The annual average pollen count was 14,460.5, with peaks in March–April and August–October. Grass pollen showed a significant correlation ($r = 0.59$) with new patient visits, while tree and weed pollens did not. Only Chenopodium album had a notable correlation with positive skin prick test results.

## 4.0 MATERIALS

Field survey

**Collection bags** : convenient bag with sufficient capacity were employed for collecting plant samples during fieldwork.

**Scissors**: Sharp cutting tools were used for safely and effectively cutting plant samples.

**Gloves:** Disposable gloves were used to prevent contact with allergenic plants and other potential hazards.

**Field notebook:** For recording plant species, location and observation details a field book was carried.

**Smartphone with GPS capability:** For accurate recording of geographic coordinates of plant locations GPS apps were used.

## Herbarium Materials

**Herbarium sheets or mounting paper:** Used for preserving plant specimens.

Plant press: For flattening and drying collected plant specimens, wooden presses with adjustable straps for uniform pressing.

**Plant identification guides or keys:** For accurate species identification Flora of Presidency of Madras was used

**Labels:** For labelling herbarium specimens with collection information.

## Pollen Collection

- **Containers:** Clean, airtight containers for preserving pollen samples.
- **Forceps:** For safely picking up pollen grains during collection.
- **Sampling materials:** Such as glass slides, coverslips, staining solution (Acetocarmine), acetic acid, mounting medium (Glycerine) and light microscope with camera for microscopic analysis.

# 5.0 METHODOLOGY

## 5.1 RESEARCH DESIGN

The Eloor Municipality extends between 76° 15' E to 76° 22' E and 9° 50' to 9° 58' N. It serves as the administrative authority for Eloor, which is organized into 45 distinct wards. The area has significant environmental challenges, including air pollution. Rapid urban development, industrial operations, and automobile exhaust emissions all contribute to rising air pollution, putting the community's health at risk.

This study utilizes a quantitative methodology to create an extensive pollen calendar for five designated regions within the vast Eloor Municipality. Renowned for its multifaceted socio-economic environment and diverse geography, this urban locale stands out for its unique attributes. The research covers a four-month span, from December 2023 to March 2024, to accurately depict the seasonal shifts in pollen dispersion characteristic of the region. The aim is to thoroughly record the seasonal fluctuations in pollen quantities and distribution patterns.

## 5.2 SAMPLING STRATEGY

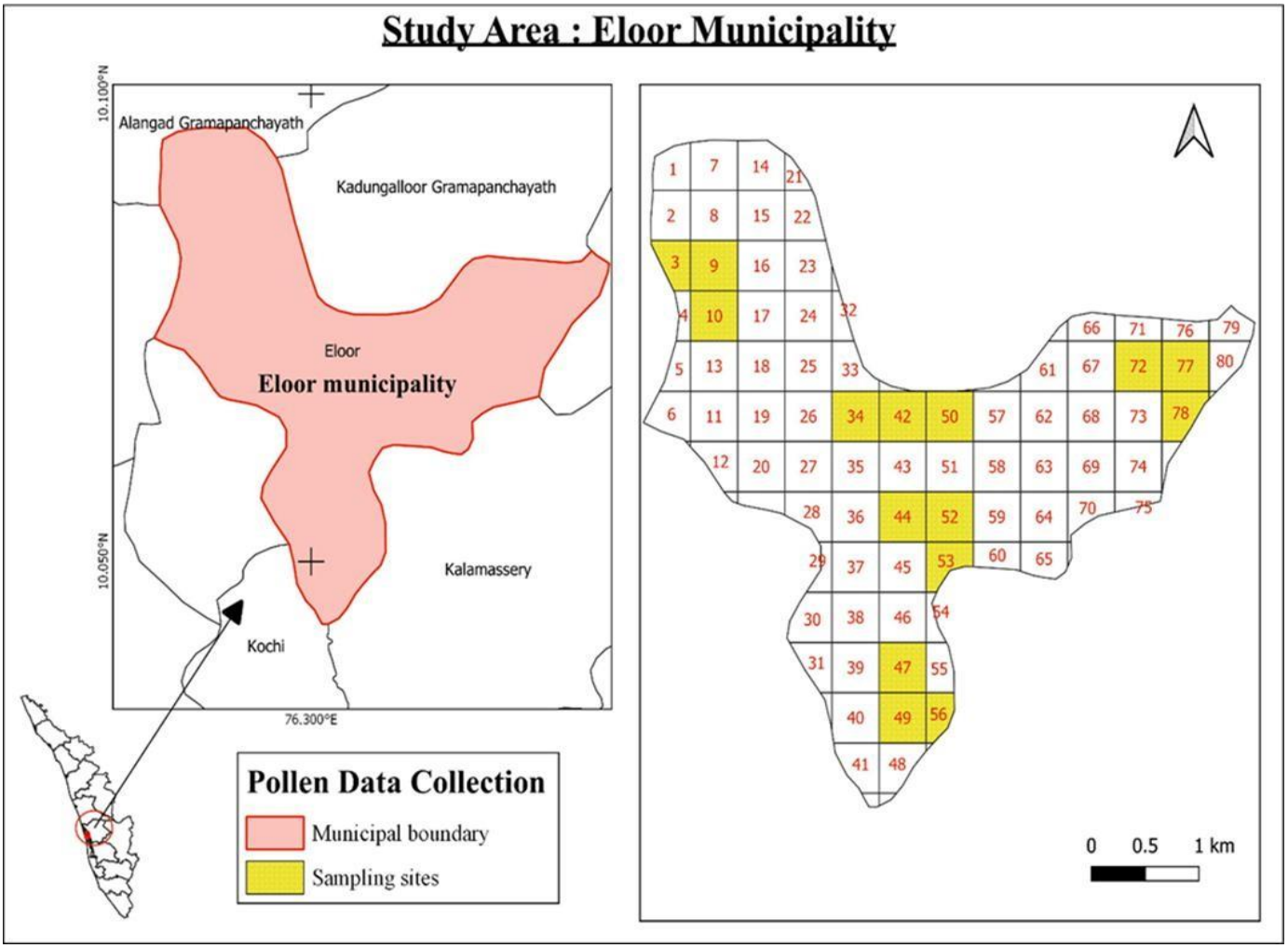



Image 2

The study area encompasses the Eloor Municipality and covers a substantial region, measuring approximately 14 square kilometers. Eloor Municipality serves as the governing body responsible for managing Eloor. The municipality is divided into 31 administrative wards. Utilizing advanced Geographic

Information Systems (GIS) technology, the area was segmented into 80 specially defined units, with each unit covering an area of 200 square metres (image 2) This systematic approach enabled a detailed and systematic analysis of the study area, facilitating an in-depth examination of pollen distribution patterns and related environmental factors.

## 5.3 SAMPLE DESIGN

A stratified random sampling method was used to guarantee representation across the research area. Stratification was done based on the 80 defined units, each representing a consistent geographical area within the Eloor municipality (McInnes et al.,2017). with some variations

## 5.4 SAMPLE SELECTION

To ensure unbiased representation, 5 units were randomly selected from the 43 established units. This random selection method was adopted to simplify travel logistics and ensure thorough coverage of the study area. Choosing 5 units from the total of 43 provides a sufficient sample size for meaningful analysis, while also considering time and resource constraints.

Five selected areas are,

1. Edamula
2. Pathalam
3. Manjummel Janatha
4. Manjummel Murukan temple
5. Eloor health centre

## 5.5 DATA COLLECTION

Data collection consists of four major components: gathering meteorological information, conducting a resident survey, conducting a botanical survey to evaluate pollen allergies and identify plants causing allergies in five zones of Eloor Municipality, and examining pollen samples from selected plant species under a microscope in the field.

- Meteorological data from December 2023 to March 2024 were acquired from **www.visualcrossing.com**. The obtained parameters include temperature, humidity, wind speed, cloud covering, and precipitation.

- Survey of Residents: Participants were chosen through convenience sampling from residential areas in the five designated units of Cochin Corporation. A survey was conducted with a total of 50 participants.

- Botanical Survey: We measured the amount of pollen allergy-causing plants, particularly wind-pollinating plants, within each unit. Sampling sites were chosen based on vegetation, density, and accessibility to ensure representative coverage of each ward.
- Pollen samples from various plant species were used to make microscopic analysis slides. The pollen was subjected to acetolysis, and the slides were dyed with Acetocarmine to improve visibility. Pollen grains were then examined under a light microscope to determine their morphology.

## 5.5 a MATERIOLOGICAL DATA

To create the pollen calendar, meteorological information was gathered from www.visualcrossing.com. The selected variables comprised temperature, wind speed, humidity, cloud cover, and rainfall. These specific factors were chosen because they are known to impact the spread of pollen and the levels of airborne pollen.


Image: 3

## 5.6 b SURVEY OF PUBLIC

The survey involved approaching individuals directly within the chosen wards using a convenience sampling technique. A structured questionnaire was crafted and given to participants to gather information on pollen allergy symptoms and associated factors. Alongside face-to-face surveys, Google forms were employed as an online tool to collect data, ensuring a wider reach and convenience for participants.

The questionnaire comprised four parts: demographic details of participants (such as age, gender, and ward number), symptoms of allergic rhinitis and asthma (including frequency, severity, and presence of symptoms like sneezing, runny nose, nasal congestion, and breathing difficulties), methods of symptom management, usage of medications and immunotherapy, and a closing question on how participants typically manage their symptoms (Townsend et al.,2023).

With the participants' permission, images were shot during the survey to capture the data gathering setting and context. Due to ethical considerations, only photos from individuals who provided consent were used in the study. The survey results were securely recorded and evaluated to establish the prevalence of pollen allergies and the severity of symptoms among inhabitants in the five designated wards. Prior to participating, participants were informed in detail about the study's objectives, procedures, and rights. All participants gave informed consent. They could opt out or exclude their images from the study without any consequences. Data collected through the Google Form was processed and presented graphically for further investigation.

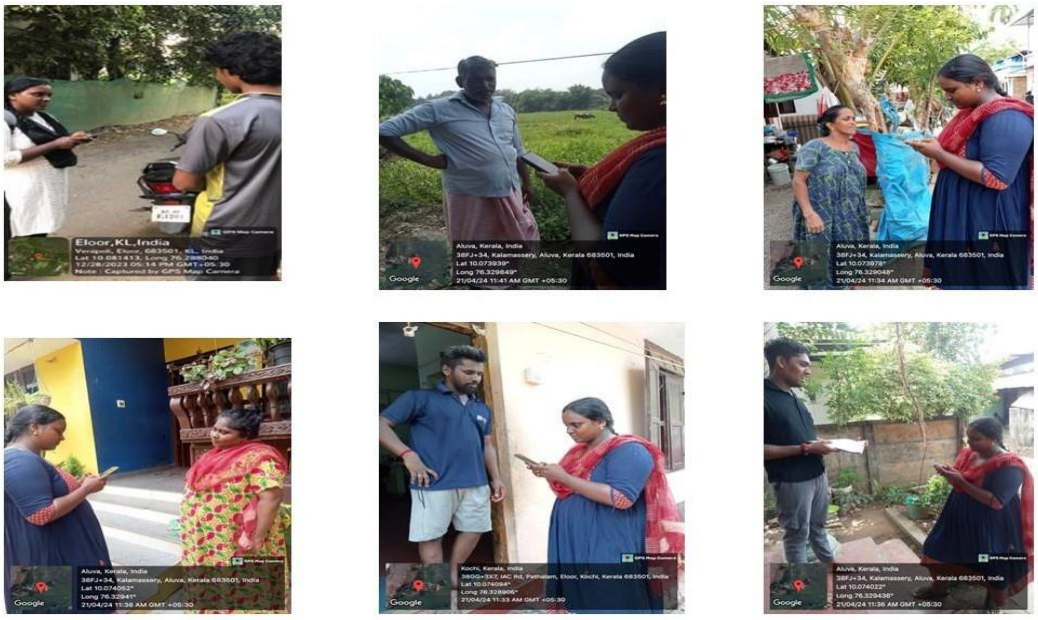



Image: 4

5.6c BOTANICAL SURVEY

A thorough botanical survey was conducted in each unit to identify and assess the prevalence of plants that cause pollen allergy. This entailed conducting systematic observations of the local vegetation in each place. The survey identified and calculated the prevalence of recognized allergenic plant species, with an emphasis on herbs and trees. Plant identification and validation were done at St. Teresa's College in Ernakulam. The flowering patterns of these allergy-inducing plants were painstakingly documented, recording both the presence of flowers and their blooming periods throughout the study. These observations were made during repeated field visits to ensure complete and accurate data collecting. Additionally, particular plant samples were collected during the study and conserved in a herbarium for future reference.

Shannon index used to measure the abundace and diversity of these plants. Shannon index is widely accepted analysis for species abundance (Gorelick et al., 2006).

Shannon index $' = -\sum_{=1} \ln i$ (Konopiński et al., 2020)


Image: 5

## 5.6 d HERBARIUM PREPARATION

To set up the herbarium, samples of wind-pollinated herbs and trees were meticulously gathered, treated, and flattened. The dataset for each sample collection included the botanical name, collection date, geographic coordinates of the collection site, and the person who collected the sample.

## 5.7 e LIGHT MICROSCOPY ANALYSIS

During the study period of December 2023 to March 2024, fresh flowers from pollen-producing plants were collected in the early morning.Several plants, including Pennisetum polystachion, Panicum repens, Kyllinga brevifolia, Mangifera indica, Cassia fistula, Peltophorum pterocarpum, Ricinus communis, Tridax procumbens, and Terminalia catappa, were collected for pollen morphology study using the acetolysis method as described by

(Obersteiner et al., 2016). The anthers of these flowers were isolated and placed on a glass slide. A drop of acetic acid was applied to the anthers, which were then crushed with a glass rod. After removing the trash, the slide was treated (Raza et al., 2020). with glycerine for staining, as per methods by Majeed(et al., 2020) and Pollen characteristics were examined using an Olympus binocular microscope, and pollen micrographs were captured at a 40x magnification.

## 5.7f FIELD BOOK

A field notebook was utilized to record detailed plant information, including the botanical name, growth pattern, family classification, date of collection, and a brief description of each plant's characteristics. This extensive documentation serves as a valuable asset for future botanical analyses and research endeavours.

# 6.0 OBESERVATIONS AND RESULT

EDAMULA

| SL NO | PLANT NAME | FAMILY | HABIT |
|---|---|---|---|
| 1 | *Eleusine indica* | POACEA | HERB |
| 2 | *Eragrostis amabilis* | POACEA | HERB |
| 3 | *Kyllinga nemoralis* | CYPERACEA | HERB |
| 4 | *Celosia argentea* | AMARANTHACEA | HERB |
| 6 | *Pennisetum polystachion* | POACEA | HERB |
| 7 | *Mangifera indica* | ANACARDIACEA | TREE |
| 8 | *Psidium guajava* | MYRTACEA | TREE |
| 9 | *Tectona grandis* | LAMIACEAE | TREE |
| 10 | *Areca catechu* | ARECACEAE | TREE |
| 11 | *Amaranthus spinosus* | AMARANTHACEA | HERB |
| 12 | *Cyanthillium cinereum* | ASTERACEA | HERB |
| 13 | *Kyllinga bulbosa* | CYPERACEAE | HERB |

| | | | |
|---|---|---|---|
| 14 | *Kyllinga polyphylla* | CYPERACEA | HERB |
| 15 | *Chromalaena odorata* | ASTERACE | HERB |
| 16 | *Cyperus rotundus* | CYPERACEAE | HERB |
| 17 | *Terminalia catappa* | COMBRETACEA | TREE |
| 18 | *Melinis repens* | POACEA | HERB |
| 19 | *Micania micrantha* | ASTERACEA | HERB |
| 20 | *Kyllinga brevifolius* | CYPERACEA | HERB |
| 21 | Panicum maximum | POACEA | HERB |
| 22 | *Panicum philadelphicum* | POACEA | HERB |
| 23 | *Pennisetum purpuram* | POACEA | HERB |
| 24 | *Leptochlon chinensis* | POACEA | HERB |
| 25 | *Artocarpus heterophyllus* | MORACEAE | TREE |
| 26 | *Syzygium cumini* | MYRTACEAE | TREE |
| 27 | *Acacia latifolia* | FABACEAE | TREE |
| 28 | *Rhapis excelsa* | ARECACEAE | TREE |
| 29 | *Amaranthus dubius* | AMARANTHACEAE | HERB |
| 30 | *Dypsis lutescens* | ARECACEAE | TREE |
| 31 | *Cyrtostachys renda* | ARECACEAE | TREE |
| 32 | *Bambusa ventricosa* | POACEAE | TREE |
| 33 | *Cynodon dactylon* | POACEAE | TREE |
| 34 | *Heteropogon contortus* | POACEAE | HERB |
| 35 | *Amaranthus tricolor* | AMARANTHACEAE | HERB |
| 36 | *Casuarina equisetifolia* | CASUARINACEAE | TREE |
| 37 | *Cyperus eragrostis* | CYPERACEAE | HERB |
| 38 | *Mimosa pudic*a | FABACEAE | HERB |

PATHALAM

| SL. NO. | PLANT NAME | FAMILY | HABIT |
|---|---|---|---|
| 1 | *Cyanthillium cinereum* | ASTERACEA | HERB |
| 2 | *Kyllinga bulbosa* | CYPERACEAE | HERB |
| 3 | *Kyllinga polyphylla* | CYPERACEA | HERB |
| 4 | *Chromalaena odorata* | ASTERACE | HERB |
| 5 | *Cyperus rotundus* | CYPERACEAE | HERB |
| 6 | *Terminalia catappa* | COMBRETACEA | TREE |
| 7 | *Melinis repens* | POACEA | HERB |
| 8 | *Micania micrantha* | ASTERACEA | HERB |
| 9 | *Kyllinga brevifolius* | CYPERACEA | HERB |
| 10 | *Eleusine indica* | POACEA | HERB |
| 11 | *Eragrostis amabilis* | POACEA | HERB |
| 12 | *Kyllinga nemoralis* | CYPERACEA | HERB |
| 13 | *Celosia argentea* | AMARANTHACEA | HERB |
| 14 | *Pennisetum polystachion* | POACEA | HERB |
| 15 | *Mangifera indica* | ANACARDIACEA | TREE |
| 16 | *Psidium guajava* | MYRTACEA | TREE |
| 17 | *Tectona grandis* | LAMIACEAE | TREE |
| 18 | *Araca catechu* | ARECACEAE | TREE |
| 19 | *Amaranthus spinosus* | AMARANTHACEA | HERB |
| 20 | *Pennisetum purpuram* | POACEA | HERB |
| 21 | *Leptochlon chinensis* | POACEA | HERB |

| | | | |
|---|---|---|---|
| 22 | *Eustachys sp.* | POACEA | HERB |
| 23 | *Bambusa vulgaris* | POACEA | TREE |
| 24 | *Gliricidia sepium* | FABACEAE | TREE |
| 25 | *Myristica fragrans* | MYRISTICACEAE | TREE |
| 26 | *Morus rubra* | MORACEAE | TREE |
| 27 | *Mimusops elengi* | SAPOTACEAE | TREE |
| 28 | *Peltophorum pterocarpum* | FABACEAE | TREE |
| 29 | *Delonix regia* | FABACEAE | TREE |
| 30 | *Cassia fistula* | FABACEAE | TREE |
| 31 | *Swietenia macrophylla* | MELIACEAE | TREE |
| 32 | *Artocarpus altilis* | MORACEAE | TREE |
| 33 | *Artocarpus hirsutus Lam.,* | MORACEAE | TREE |
| 34 | *Artocarpus heterophyllus* | MORACEAE | TREE |
| 35 | *Syzygium cumini* | MYRTACEAE | TREE |
| 36 | *Acacia latifolia* | FABACEAE | TREE |
| 37 | *Rhapis excelsa* | ARECACEAE | TREE |
| 38 | *Amaranthus dubius* | AMARANTHACEAE | HERB |
| 39 | *Dypsis lutescens* | ARECACEAE | TREE |
| 40 | *Cyrtostachys renda* | ARECACEAE | TREE |
| 41 | *Bambusa ventricosa* | POACEAE | TREE |
| 42 | *Cynodon dactylon* | POACEAE | TREE |
| 43 | *Heteropogon contortus* | POACEAE | HERB |
| 44 | *Amaranthus tricolor* | AMARANTHACEAE | HERB |
| 45 | *Casuarina equisetifolia* | CASUARINACEAE | TREE |
| 46 | *Cyperus eragrostis* | CYPERACEAE | HERB |
| 47 | *Mimosa pudica* | FABACEAE | HERB |
| 48 | *Ricinus communis* | EUPHORBACEAE | TREE |

MANJUMMEL JANATHA

| SL. NO | PLANT NAME | FAMILY | HABIT |
|---|---|---|---|
| 1 | *Artocarpus heterophyllus* | MORACEAE | TREE |
| 2 | *Syzygium cumini* | MYRTACEAE | TREE |
| 3 | *Acacia latifolia* | FABACEAE | TREE |
| 4 | *Rhapis excelsa* | ARECACEAE | TREE |
| 5 | *Amaranthus dubius* | AMARANTHACEAE | HERB |
| 6 | *Dypsis lutescens* | ARECACEAE | TREE |
| 7 | *Cyrtostachys renda* | ARECACEAE | TREE |
| 8 | *Bambusa ventricosa* | POACEAE | TREE |
| 9 | *Cynodon dactylon* | POACEAE | TREE |
| 10 | *Heteropogon contortus* | POACEAE | HERB |
| 11 | *Amaranthus tricolor* | AMARANTHACEAE | HERB |
| 12 | *Casuarina equisetifolia* | CASUARINACEAE | TREE |
| 13 | *Cyperus eragrostis* | CYPERACEAE | HERB |
| 14 | *Mimosa pudica* | FABACEAE | HERB |
| 15 | *Ricinus communis* | EUPHORBACEAE | TREE |
| 16 | *Eleusine indica* | POACEA | HERB |
| 17 | *Eragrostis amabilis* | POACEA | HERB |
| 18 | *Kyllinga nemoralis* | CYPERACEA | HERB |
| 19 | *Celosia argentea* | AMARANTHACEA | HERB |

| | | | |
|---|---|---|---|
| 20 | *Pennisetum polystachion* | POACEA | HERB |
| 21 | *Mangifera indica* | ANACARDIACEA | TREE |
| 22 | *Psidium guajava* | MYRTACEA | TREE |
| 23 | *Tectona grandis* | LAMIACEAE | TREE |
| 24 | *Areca catechu* | ARECACEAE | TREE |
| 25 | *Amaranthus spinosus* | AMARANTHACEA | HERB |
| 26 | *Cyanthillium cinereum* | ASTERACEA | HERB |
| 27 | *Kyllinga bulbosa* | CYPERACEAE | HERB |
| 28 | *Kyllinga polyphylla* | CYPERACEA | HERB |
| 29 | *Chromalaena odorata* | ASTERACE | HERB |
| 30 | *Cyperus rotundus* | CYPERACEAE | HERB |
| 31 | *Terminalia catappa* | COMBRETACEA | TREE |
| 32 | *Melinis repens* | POACEA | HERB |
| 33 | *Micania micrantha* | ASTERACEA | HERB |
| 34 | *Kyllinga brevifolius* | CYPERACEA | HERB |
| 35 | Panicum maximum | POACEA | HERB |
| 36 | *Panicum philadelphicum* | POACEA | HERB |
| 37 | *Pennisetum purpuram* | POACEA | HERB |

MANJUMMEL MURUKAN TEMPLE

| SL. NO | PLANT NAME | FAMILY | HABIT |
|---|---|---|---|
| 1 | *Eleusine indica* | POACEA | HERB |
| 2 | *Eragrostis amabilis* | POACEA | HERB |
| 3 | *Kyllinga nemoralis* | CYPERACEA | HERB |
| 4 | *Celosia argentea* | AMARANTHACEA | HERB |
| 5 | *Pennisetum polystachion* | POACEA | HERB |
| 6 | *Mangifera indica* | ANACARDIACEA | TREE |
| 7 | *Psidium guajava* | MYRTACEA | TREE |
| 8 | *Tectona grandis* | LAMIACEAE | TREE |
| 9 | *Araca catechu* | ARECACEAE | TREE |
| 10 | *Amaranthus spinosus* | AMARANTHACEA | HERB |
| 11 | *Cyanthillium cinereum* | ASTERACEA | HERB |
| 12 | *Kyllinga bulbosa* | CYPERACEAE | HERB |
| 13 | *Kyllinga polyphylla* | CYPERACEA | HERB |
| 14 | *Chromalaena odorata* | ASTERACE | HERB |
| 15 | *Cyperus rotundus* | CYPERACEAE | HERB |
| 16 | *Terminalia catappa* | COMBRETACEA | TREE |
| 17 | *Melinis repens* | POACEA | HERB |
| 18 | *Micania micrantha* | ASTERACEA | HERB |
| 19 | *Kyllinga brevifolius* | CYPERACEA | HERB |
| 20 | Panicum maximum | POACEA | HERB |
| 21 | *Panicum philadelphicum* | POACEA | HERB |
| 22 | *Pennisetum purpuram* | POACEA | HERB |
| 23 | *Leptochlon chinensis* | POACEA | HERB |
| 24 | *Eustachys sp.* | POACEA | HERB |
| 25 | *Bambusa vulgaris* | POACEA | TREE |
| 26 | *Gliricidia sepium* | FABACEAE | TREE |
| 27 | *Myristica fragrans* | MYRISTICACEAE | TREE |
| 28 | *Morus rubra* | MORACEAE | TREE |
| 29 | *Mimusops elengi* | SAPOTACEAE | TREE |

| | | | |
|---|---|---|---|
| 30 | *Peltophorum pterocarpum* | FABACEAE | TREE |
| 31 | *Delonix regia* | FABACEAE | TREE |
| 32 | *Cassia fistula* | FABACEAE | TREE |
| 33 | *Swietenia macrophylla* | MELIACEAE | TREE |
| 34 | *Artocarpus altilis* | MORACEAE | TREE |
| 35 | *Artocarpus hirsutus Lam.,* | MORACEAE | TREE |
| 36 | *Artocarpus heterophyllus* | MORACEAE | TREE |

ELOOR HEALTH CENTRE

| SL. NO | PLANT NAME | FAMILY | HABIT |
|---|---|---|---|
| 1 | *Eleusine indica* | POACEA | HERB |
| 2 | *Eragrostis amabilis* | POACEA | HERB |
| 3 | *Kyllinga nemoralis* | CYPERACEA | HERB |
| 4 | *Celosia argentea* | AMARANTHACEA | HERB |
| 5 | *Pennisetum polystachion* | POACEA | HERB |
| 6 | *Mangifera indica* | ANACARDIACEA | TREE |
| 7 | *Psidium guajava* | MYRTACEA | TREE |
| 8 | *Tectona grandis* | LAMIACEAE | TREE |
| 9 | *Araca catechu* | ARECACEAE | TREE |
| 10 | *Amaranthus spinosus* | AMARANTHACEA | HERB |
| 11 | *Cyanthillium cinereum* | ASTERACEA | HERB |
| 12 | *Kyllinga bulbosa* | CYPERACEAE | HERB |
| 13 | *Kyllinga polyphylla* | CYPERACEA | HERB |
| 14 | *Chromalaena odorata* | ASTERACE | HERB |
| 15 | *Cyperus rotundus* | CYPERACEAE | HERB |
| 16 | *Terminalia catappa* | COMBRETACEA | TREE |
| 17 | *Melinis repens* | POACEA | HERB |
| 18 | *Micania micrantha* | ASTERACEA | HERB |
| 19 | *Kyllinga brevifolius* | CYPERACEA | HERB |
| 20 | Panicum maximum | POACEA | HERB |
| 21 | *Panicum philadelphicum* | POACEA | HERB |
| 22 | *Pennisetum purpuram* | POACEA | HERB |
| 23 | *Leptochlon chinensis* | POACEA | HERB |
| 24 | *Eustachys sp.* | POACEA | HERB |
| 25 | *Bambusa vulgaris* | POACEA | TREE |
| 26 | *Gliricidia sepium* | FABACEAE | TREE |
| 27 | *Myristica fragrans* | MYRISTICACEAE | TREE |
| 28 | *Morus rubra* | MORACEAE | TREE |
| 29 | *Mimusops elengi* | SAPOTACEAE | TREE |
| 30 | *Peltophorum pterocarpum* | FABACEAE | TREE |
| 31 | *Delonix regia* | FABACEAE | TREE |
| 32 | *Cassia fistula* | FABACEAE | TREE |
| 33 | *Swietenia macrophylla* | MELIACEAE | TREE |
| 34 | *Artocarpus altilis* | MORACEAE | TREE |
| 35 | *Artocarpus hirsutus Lam.,* | MORACEAE | TREE |
| 36 | *Artocarpus heterophyllus* | MORACEAE | TREE |
| 37 | *Dypsis lutescens* | ARECACEAE | TREE |
| 38 | *Cyrtostachys renda* | ARECACEAE | TREE |
| 40 | *Bambusa ventricosa* | POACEAE | TREE |

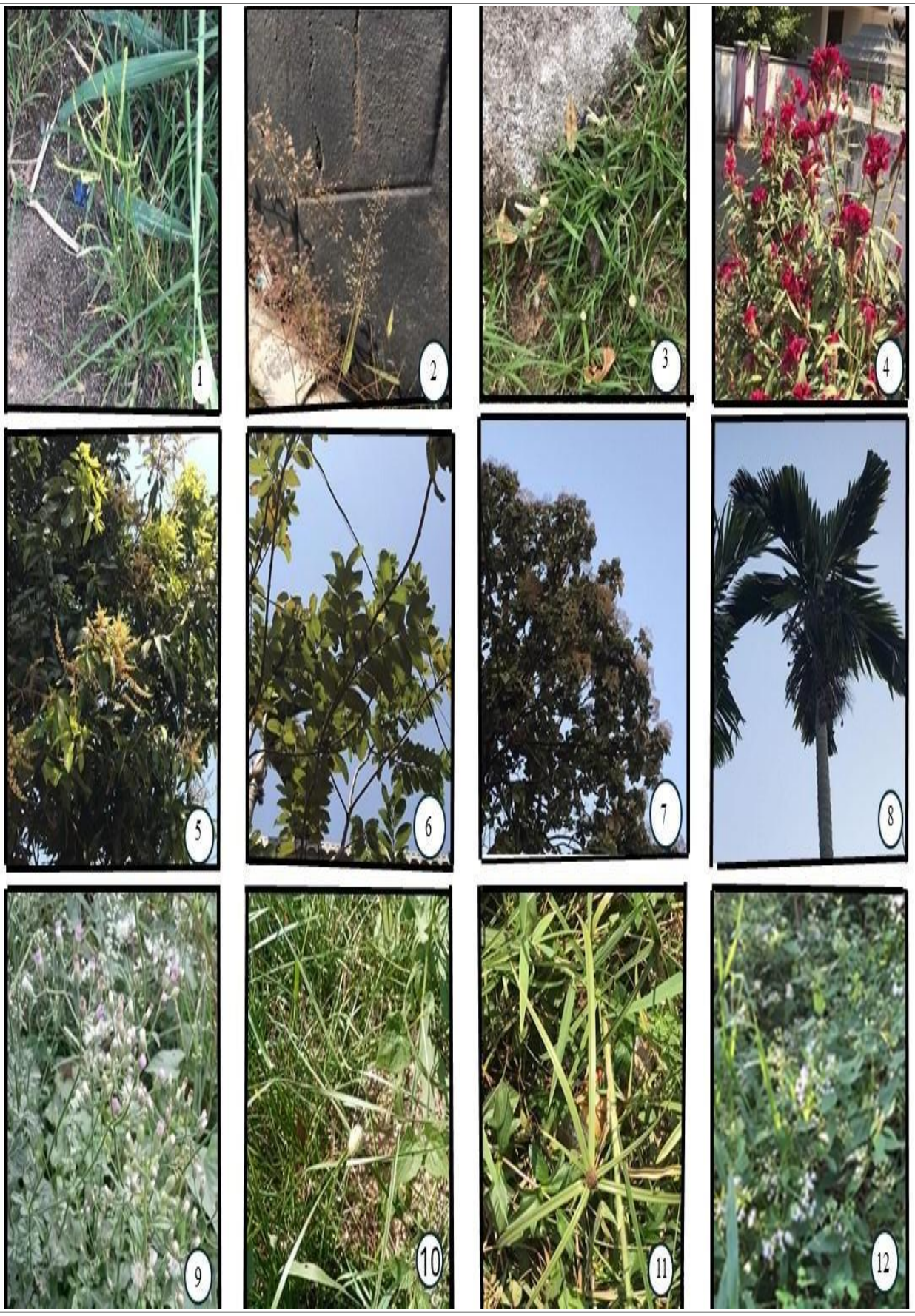



Image: 6

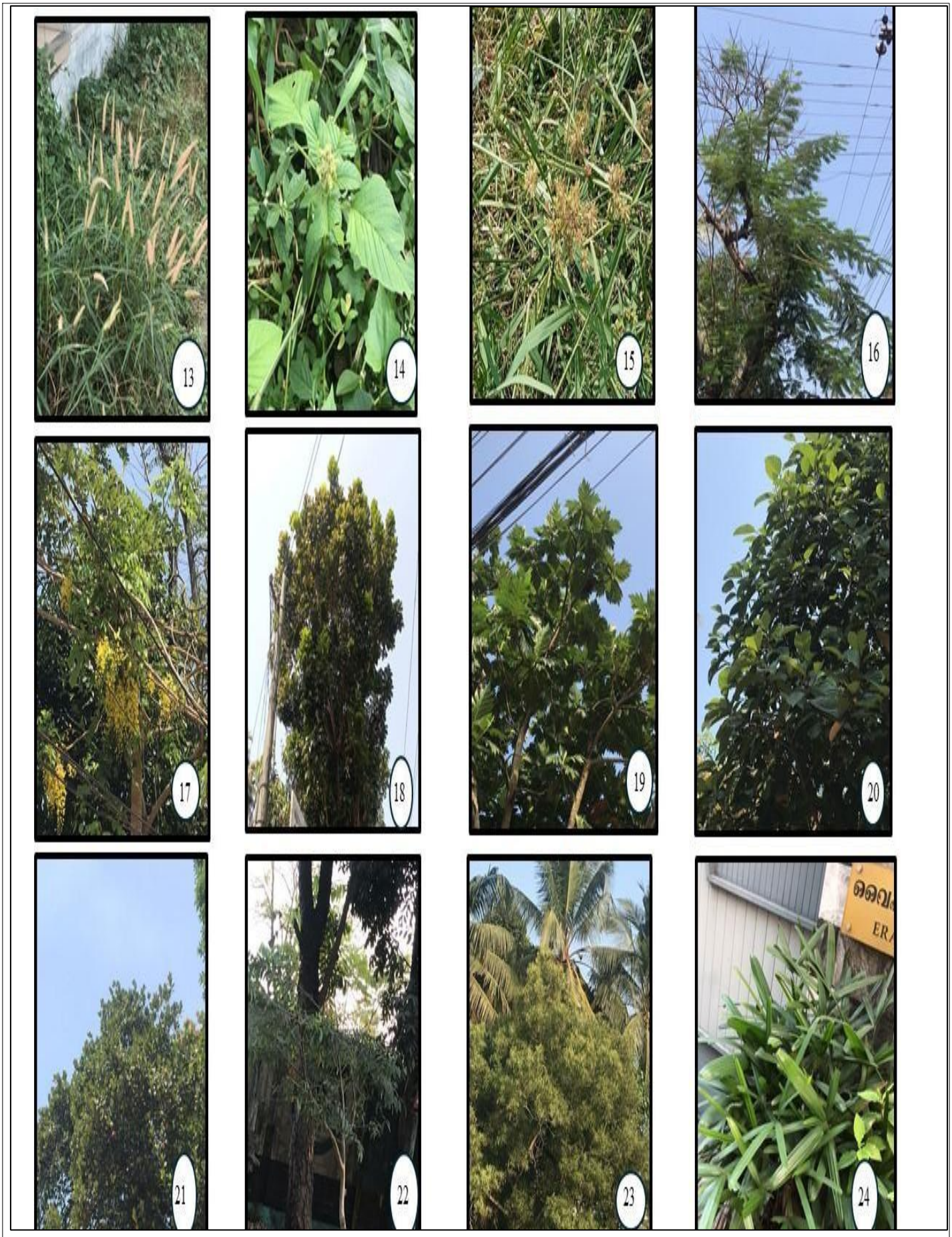



Image: 7

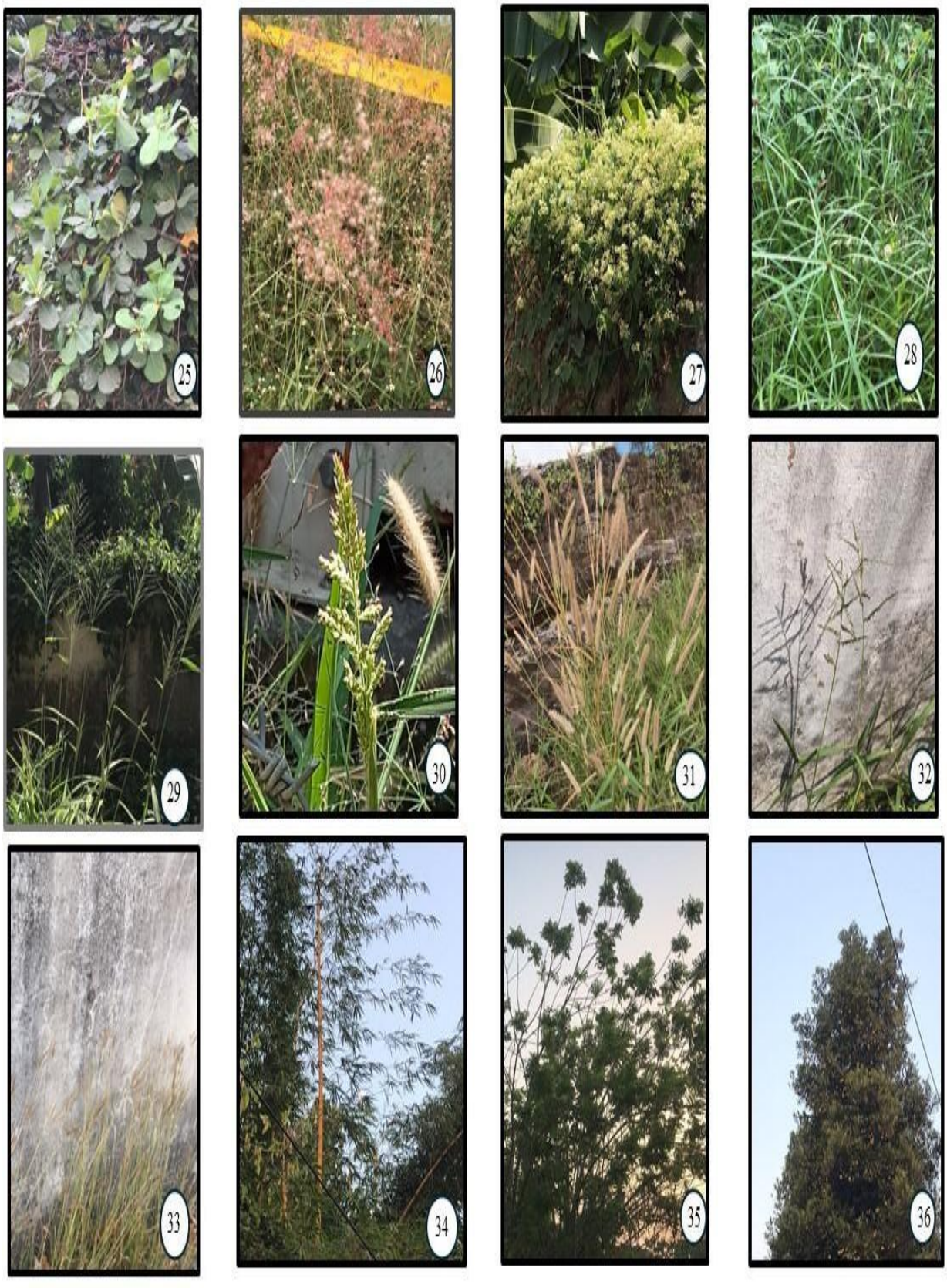



Image: 8

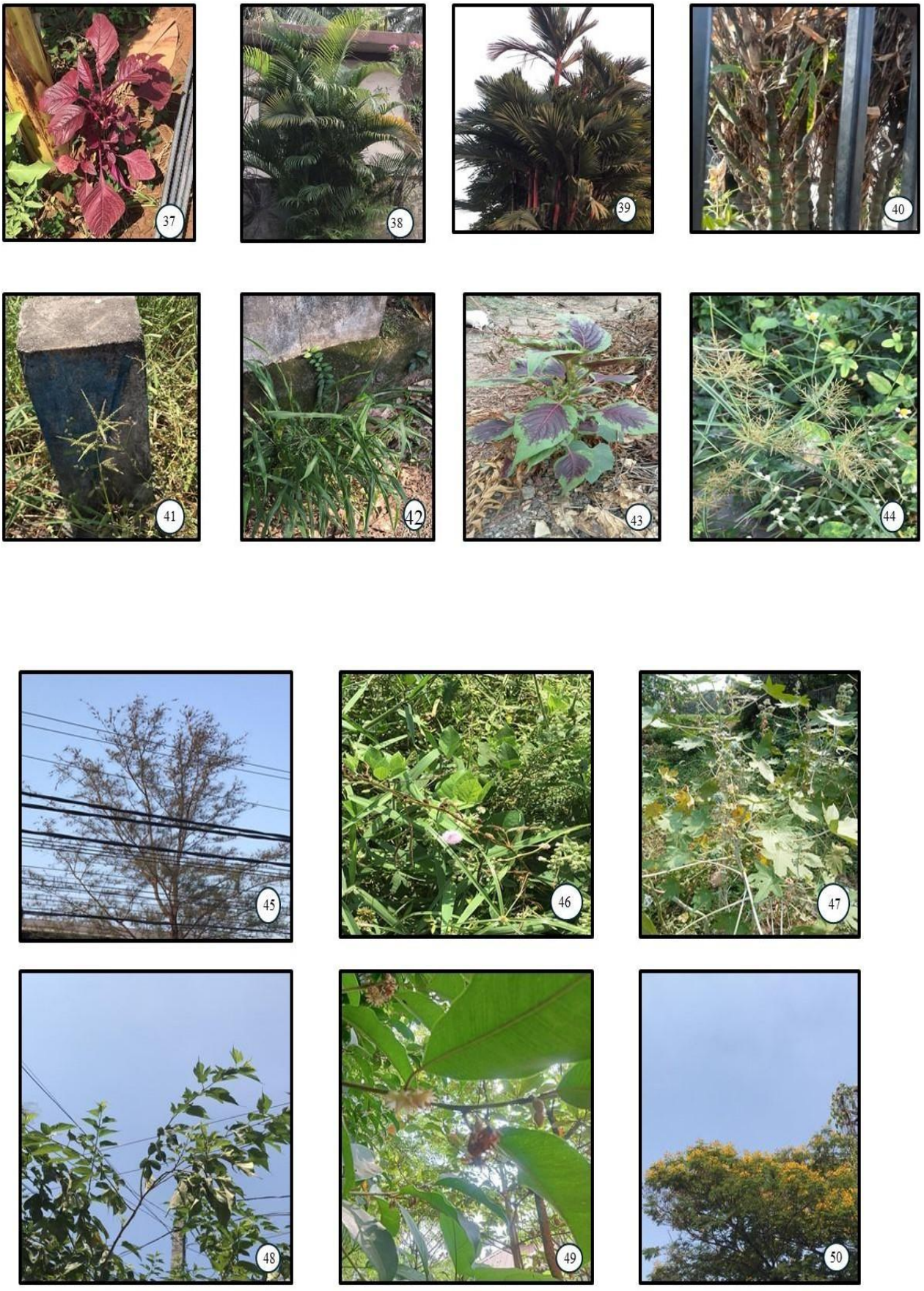



Image: 9

*1.Eleusine indica*

It is a plant that grows year after year. They develop as tufts or mats. The culms are thin and compact. The leaves are alternately arranged, and the leaf blade is flat and linear, with a noticeable midrib and a rough texture. The culms have spike-like raceme inflorescences that grow from the center of the tuft. It is made up of tiny spikelets aligned along the central axis.

2. *Eragrostis amabilis*

*Eragrostis amabilis,* often known as Lovegrass, is a grass that can be either annual or perennial. It often forms tufts with slender, linear leaves and scarlet sheaths. The open, branched panicle inflorescence has lanceolate to oblong spikelets containing one to numerous awnless florets. The culms are slender and upright, and the seeds are tiny, oblong, and reddish brown. It flourishes in open places, roadsides. Fibrous root system that supports growth

3. *Kyllinga nemoralis*

*Kyllinga nemoralis* is a short, tuft-forming sedge native to India. It has triangular stems and slender leaves with reddish brown sheaths. At the plant's summit, tiny brown spikelets form thick clusters. It thrives in wet, shady environments such as stream banks.

*4.Celosia argentea*

*Celosia argentea* is an annual or short-lived perennial herb that can reach 30-90 cm in height and has robust, branching stems and lanceolate to ovate leaves. Its unique inflorescence is a dense spike or large, flattened head in a variety of colors, including red, pink, yellow, orange, and purple. It is frequently found in gardens, waste areas, and cultivated fields throughout India.

*5.Mangifera indica*

It's a huge evergreen tree. It has a spreading canopy that ranges from spherical to oval in shape. The bark is smoother in younger trees and rougher in older ones.The leaves are simple, alternating, and lanceolate in form, with full edges. They are normally dark green, glossy on the upper surface, and light green on the underside. The blooms are tiny and fragrant, and the inflorescence is a panicle. The flowers feature five sepals and petals that range from white to yellow. The fruit is a drupe with one big seed surrounded by fibrous flesh.

6. *Psidium guajava*

*Psidium guajava*, or guava, is a tiny tree that grows to a height of 3-6 meters. It has smooth, greenish-brown bark, glossy green oval to oblong leaves, and five-petaled white blooms. The fruit is spherical or pear-shaped, 5-10 cm in diameter, and when ripe, transforms from green to yellow or light green, holding numerous little, firm seeds. Guava is widely planted in gardens and orchards throughout India.

7. *Tectona grandis*

*Tectona grandis*, sometimes known as teak, is a huge deciduous tree that is highly valued for its timber. It has a tall, straight trunk with grayish-brown bark and huge, simple oval leaves that are glossy green on the top and pale green on the bottom. The tree produces little white blooms in tight clusters that mature into hard, woody fruits. Teak is extensively farmed in plantations throughout India for its high-quality timber.

8. *Araca catechu*

*Areca catechu*, sometimes known as Areca palm, is a medium-sized palm tree. It has slender, straight stems with grayish to brownish bark and huge, green, glossy pinnate leaves. The tree produces small, yellowish-orange fruits with a solitary seed inside a fibrous husk. The betel palm is widely grown in gardens and plantations throughout India for its seeds, which are used to make betel quid.

9. *Cyanthillium cinereum*

*Cyanthillium* cinereum is a tiny herbaceous plant native to India. It has a spreading growth pattern and several erect or ascending stems. The leaves are simple, lanceolate to ovate, and alternately placed on the stalks. The plant produces a large number of little lilac to pinkish-purple flower heads that cluster at the terminals of the stems. Each flower head is made up of tubular disc florets encircled by many rows of bracts. Little ironweed is often found in open fields, waste areas, and along roadsides throughout India.

10. *Kyllinga bulbosa*

*Kyllinga bulbosa* is a perennial sedge endemic to India, known for its low growth and slender, creeping rhizomes. The stems have a triangular cross shape and can reach heights of up to 30 cm. The leaves are linear, slender, and shorter than the stems, with open sheaths and membrane ligules adorned with hairs. The inflorescence is made up of small, brownish spikelets densely packed in cylindrical clusters at the tops of the stalks.

*11. Kyllinga polyphylla*

*Kyllinga polyphylla* is a perennial sedge endemic to India, known for its low growth and slender, creeping rhizomes. The stems are trapezoidal in cross section and normally reach a height of 10-30 cm. The leaves are linear and slender, generally shorter than the stems, with open sheaths and membrane ligules adorned with hairs. The inflorescence is made up of small, brownish spikelets densely packed in cylindrical clusters at the tops of the stalks.

*12. Chromolaena odorata*

*Chromolaena odorata* is a perennial herbaceous plant that grows widely throughout India. It grows upright, with branching branches reaching heights of up to 2-3 meters. The leaves are simple, opposite, and ovate to lanceolate in form, with serrated margins that emit a unique strong odor when crushed. The plant produces little, white to lavender blooms that grow in thick clusters at the terminals of the branches. Commonly found in disturbed regions, roadsides, and agricultural grounds .

*13. Pennisetum polystachion*

*Pennisetum polystachion*, sometimes known as mission grass, is a vigorous perennial grass endemic to India that grows to a height of 1-2 meters. It has upright, strong stems with narrow, linear leaflets and thick cylindrical spike-like panicles that measure 10-30 cm long. The spikelets are tiny, lanceolate to oblong, and awnless. It is commonly found in open grasslands, along roadsides, and disturbed places throughout India.

*14. Amaranthus spinosus*

*Amaranthus spinosus* is an annual herbaceous plant. It grows erect, with a branching stem coated in sharp spines. The leaves are alternating, oval to lanceolate in form, and frequently show a reddish color. Green to reddish-brown blooms grow in thick, spiky clusters at the terminals of the stems. The seeds are tiny, glossy, and black. Spiny amaranth is often found in wastelands, cultivated fields, and disturbed soils throughout India.

*15. Cyperus rotundus*

Cyperus rotundus, also known as cocograss, is a perennial sedge. It has a network of slender, underground rhizomes that produce triangular stems that can reach heights of up to 40-90 cm. The leaves are linear and grass-like, grouped in threes at the base of the stems. The plant produces small, brown spikelets gathered in umbrella-like inflorescences at the tips of its branches.

*16. Delonix regia*

Delonix regia is a big deciduous tree. It has a wide-spreading canopy, a short, irregularly curved trunk, and smooth, grayish brown bark. The leaves are bipinnate, alternating, and fern-like, with many tiny leaflets. The tree bears huge, beautiful, bright red or orange blooms in thick, terminal clusters. The fruits are flat, woody pods that can grow up to 60 cm long and contain several seeds imbedded in a fluffy, cotton-like material.

*17. Cassia fistula*

Cassia fistula, often known as the golden shower tree, is a medium-sized deciduous tree that grows to be 10 to 20 meters tall. It has smooth, grayish-brown bark and a broad, open canopy. The leaves are pinnate, with 6-8 pairs of elongated leaflets in a bright green shade. The tree blooms with beautiful yellow flowers clustered in long, hanging clusters, hence its common name. Its fruit is a long, dark-brown pod that measures 30-60 cm in length and contains several seeds wrapped in a sticky material.

*18. Swietenia macrophylla*

Swietenia macrophylla, often known as big-leaf mahogany, is a huge deciduous tree that can grow to 30-40 meters tall. It is distinguished by a straight trunk that can grow up to 1-2 meters in diameter and a rounded crown of big, pinnate leaves. The leaves are made up of four to eight pairs of rectangular leaflets with a glossy green surface. The tree has small, fragrant whitish-pink flowers that form panicles. The fruit is a huge, woody capsule measuring 15-30 cm in length and containing several winged seeds.

*19. Artocarpus hirsutus Lam.*

Artocarpus hirsutus Lam., often known as wild jack or hairy-fruited jack, is a medium-sized evergreen tree that reaches a height of 10-15 meters. It is distinguished by its dense, spherical canopy and rough, brownish bark. The leaves are big and oval, with a hairy texture on the underside. The tree bears spherical to ovoid fruits with a green, prickly skin that becomes yellowish-brown when mature. The fruit has a delicious, yellowish pulp enclosing big seeds.

*20. Artocarpus altilis*

Artocarpus altilis, sometimes known as breadfruit, is a huge tropical tree that can reach heights of 20-30 meters. It is distinguished by its large, spreading canopy and smooth, grayish bark. The leaves are big, deeply lobed, glossy green, and shaped like a hand. The tree bears round to oval-shaped fruits weighing up to several kilograms, with a green, prickly skin that turns yellowish-green when ripe.

21 . *Artocarpus heterophyllus*

Artocarpus is a tree and shrub genus best recognized for its big, complex leaves and tasty fruits. Artocarpus is a genus of plants and shrubs characterized by big, complex leaves and edible fruits. Trees range in size from small bushes to huge trees with heights of 20-30 meters. They usually have a large, spreading canopy and smooth or rough bark. The leaves are big, usually deeply lobed or pinnate, and glossy green. The fruits range in shape and size from spherical to rectangular, and the skin can be prickly or smooth. The fruits include a sweet or starchy pulp surrounded by big seeds.

*22. Ricinus communis*

Ricinus communis, sometimes known as the castor oil plant, is a fast-growing, semi-woody shrub or small tree that can reach a height of 2-6 meters. It is distinguished by its huge palmate leaves, which have 5-11 strongly lobed, lanceolate leaflets. The leaves are glossy green with reddish veins and borders, creating a stunning look. The plant produces little greenish-yellow blooms in terminal panicles. The fruit is a spiny, spherical capsule with glossy, bean-like seeds that produce castor oil.

*23. Acacia latifolia*

Acacia latifolia is a medium-sized evergreen tree that can reach heights of 10-15 meters. It's distinguished by its spreading, umbrella-shaped canopy and smooth, grayish bark. The leaves are bipinnate, with many tiny leaflets, and stand out because to their broad shape. The tree produces small, spherical yellow flower heads that are arranged in dense racemes. The fruit is a flat, brown pod with many seeds.

*24. Rhapis excelsa*

Rhapis excelsa, often known as the lady palm, is a multi-stemmed, clumping palm that grows up to 2-4 meters tall. It has slender, bamboo-like stems and fan-shaped leaves. The leaves are deeply divided into several parts, giving them a lush, tropical appearance. The plant produces little, yellowish blooms that blend nicely with the foliage. The fruit is a tiny circular drupe with a single seed

*25. Terminalia catappa*

Terminalia catappa, often known as the Indian almond or tropical almond, is a big, deciduous tree endemic to India. It has a spreading canopy, a straight trunk, and smooth grayish-brown bark. The leaves are simple, alternating, and widely elliptic with a pointed tip. They turn red or yellow before dropping. The tree produces little, greenish-yellow blooms that are inconspicuous but fragrant, followed by meaty, flattened fruits resembling almonds, each containing a big seed.

*26. Melinis repens*

27. Melinis repens, often known as Natal redtop or rose Natal grass, is a perennial grass. It often develops dense clumps and can reach a height of 1-2 meters. The stems are slim, upright, and generally reddish in color. The leaves are linear, thin, and frequently folded, with a distinct midrib and hairy margins. The inflorescence is made up of purplish-red or pinkish spike-like panicles that appear fluffy because of the spikelets' long, silky hairs. This grass is frequently found in open meadows, along roadsides, and disturbed regions.

*27. Micania micrantha*

Mikania micrantha, often known as bittervine or mile-a-minute weed, is a rapidly growing perennial vine. It has slender, twining stems that can grow up to 9 meters in length, producing dense mats over surrounding vegetation. The leaves are opposite, widely ovate to heart-shaped, with serrated edges. The plant has small, white to pale purple flowers crowded in terminal panicles. The fruits are tiny achenes with bristles for wind distribution. This aggressive invader is frequently found in woods, plantations, and disturbed regions.

*28. Kyllinga brevifolius*

Kyllinga brevifolius is a perennial sedge native to India, distinguished by its moderate growth rate and narrow, creeping rhizomes. The stems are trapezoidal in cross section and normally reach a height of 10-30 cm. The leaves are linear and slender, generally shorter than the stems, with open sheaths and membrane ligules adorned with hairs. The inflorescence is made up of small, brownish spikelets densely packed in cylindrical clusters at the tops of the stalks. This sedge is typically found in wet, shady areas such as stream banks and woods.

*29. Panicum philadelphicum*

It often grows in dense clumps and can reach heights of 60-120 cm. The stems are slender, upright, and frequently branch around the base. The leaves are linear, alternating, and feature a pronounced midrib with parallel veins. The inflorescence is a loose, open panicle containing many tiny, greenish spikelets. This grass is frequently found in open fields, meadows, and disturbed regions.

*30. Pennisetum purpuram*

It has a strong growth habit and can reach heights of 2-4 meters. The stems are thick, upright, and might be unbranched or sparingly branched near the base. The leaves are tall and slender, with a pronounced midrib

and a purplish-red base. The inflorescence is a broad, cylindrical panicle containing violet to brownish spikelets.

*31. Leptochloa chinensis*

*Leptochloa chinensis* is a grass that grows either annually or perennially. It often grows in dense tufts and can reach heights of 30-60 cm. The stems are slender, erect, and frequently branch at the base. The leaves are straight, thin, and feature a pronounced midrib with parallel veins. The inflorescence consists of a compact, cylindrical spike-like panicle with tiny, green spikelets. This grass is frequently found in wetlands, marshes, and disturbed places.

*32. Eustachys sp.*

Eustachys sp. are perennial grasses distinguished by their sluggish growth rate and unusual inflorescence. The stems are either prostrate or ascending, and the nodes are thickly hairy. The leaves are linear and small, and they can be found either at the base or along the stem. The inflorescence is a dense, spike-like panicle with short branches and small spikelets. These grasses are often found in open meadows, along roadsides, and disturbed regions .

*33. Bambusa vulgaris*

Bambusa vulgaris, sometimes known as common or golden bamboo, is a big clump-forming bamboo species. It has tall, upright, cylindrical culms (stems) with diameters ranging from 10 to 20 cm and heights of up to 15-30 meters. The culms are green when young, yellowish with age, and frequently feature conspicuous nodes. Linear, lanceolate leaves grow in tufts on the branches, each with a pointed tip and a sheathing base.

*34. Gliricidia sepium*

Gliricidia sepium is a medium-sized, fast-growing tree that is frequently planted in India. It has a wide canopy, a short, crooked trunk, and smooth, grayish-brown bark. The leaves are complex, pinnate, and alternating, with 7-19 pairs of leaflets ranging in shape from elliptic to ovate with pointy points. The tree produces small, pink to lavender blooms clustered at the terminals of its branches. The fruits are flat brown pods with many seeds. Gliricidia sepium is an important multipurpose tree in agroforestry systems in India, where it is commonly utilized as a shade tree, live fence, and for nitrogen-fixing purposes.

*35. Myristica fragrans*

Myristica fragrans, or nutmeg, is a medium-sized evergreen tree grown in India and other tropical climates. It features a pyramidal canopy, a straight, slender trunk, and grayish brown bark. The leaves are simple,

alternating, elliptic to oblong in form, with whole edges and pinnate veining. The tree produces small, pale yellow flowers that can be male or female, with the female flowers growing into meaty, yellowish fruits with a single seed known as nutmeg. The seed is coated with a red aril known as mace.

*36. Amaranthus dubius*

Amaranthus dubius, often known as red spinach or slender amaranth, is an annual herbaceous plant that reaches a height of 50-100 cm. It has erect, branching branches and leaves that range from lanceolate to ovate. The leaves range in color from green to reddish-purple and have a smooth or slightly serrated border. The plant has small, inconspicuous green blooms grouped in dense, terminal spikes. The seeds are tiny, glossy, black, and wrapped in a papery capsule.

*37. Dypsis lutescens*

Dypsis lutescens, often known as the areca palm or golden cane palm, is a medium-sized clumping palm that grows to heights of 6-12 meters. It is distinguished by its slender, yellow-green stems and arching, feathery fronds. The fronds are pinnate, with several leaflets grouped in a V-shaped pattern along the rachis, giving the palm a beautiful and tropical appearance. The plant produces little, yellow flowers that bloom on branched inflorescences that emerge from between the leaves.

*38. Cyrtostachys renda*

Cyrtostachys renda, often known as the lipstick palm or red sealing wax palm, is a stunning palm species that grows to heights of 6-12 meters. It is distinguished by its slender, brilliant scarlet to maroon stems that are heavily ringed with leaf scars. The leaves are pinnate, with multiple leaflets grouped in a V-shape along the rachis, and bright green in colour. The plant produces little, creamy white flowers that bloom on branched inflorescences that emerge from between the leaves. The fruit is a tiny, oval-shaped drupe with one seed.

*39. Bambusa ventricose*

Bambusa ventricosa, sometimes known as Buddha's belly bamboo, is a distinctive and attractive bamboo species that normally reaches a height of 6-12 meters. It is distinguished by its inflated, bulbous internodes, which give the culms their distinctive "belly" shape. The culms are green with vertical stripes and grow in a slightly zigzag style. The leaves are lanceolate, glossy green, and normally measure 15-30 cm long.

*40. Cynodon dactylon*

Cynodon dactylon is a creeping, perennial grass that grows densely and slowly. It is distinguished by its wiry, stoloniferous stems that root at the nodes, allowing it to spread quickly and form a dense mat. The

leaves are flat, slender, and normally 2-15 cm long. They are green to grayish-green in hue and feature a distinct midrib. The grass has little greenish-purple blooms on short spikes that sprout from the leaf axils.

*41. Heteropogon contortus*

Heteropogon contortus is a perennial grass. It is distinguished by its strong, tufted growth habit and erect or slightly bent branches. The leaves are straight, flat, and can range in hue from green to reddish brown. The inflorescence is made up of a thick, cylindrical spike-like panicle that is frequently twisted or contorted The spikelets are organized in pairs, one fertile and the other sterile, and they feature long, bristly awns with twisted bases.

*42. Amaranthus tricolor*

Amaranthus tricolor is an annual herbaceous plant that grows to a height of 50–150 cm. It is distinguished by its upright, branching branches and ovate to lanceolate leaves, which are frequently variegated with colors of green, red, yellow, and purple, providing a vibrant show. The plant has small, inconspicuous green blooms that grow in dense, terminal spikes. The seeds are tiny, glossy, and black. They are contained in a papery capsule.

*43. Cyperus eragrostis*

Cyperus eragrostis, often known as tall flatsedge or umbrella flatsedge, is a perennial herbaceous plant that grows in dense clusters to heights of 60-150 cm. It is distinguished by its slender, triangular stems that are frequently ridged and capp

*44. Casuarina equisetifolia*

Casuarina equisetifolia is an evergreen tree that can reach heights of 20-35 meters. It has slender, jointed branches that resemble horsetails. The tree has a conical or cylindrical shape with a dense, open canopy of drooping branchlets. The leaves are reduced to microscopic scales that surround the stem joints. The tree has small, inconspicuous flowers followed by cone-like fruiting structures holding numerous winged seeds.

*45. Mimosa pudica* (img 53)

Mimosa pudica, sometimes known as the sensitive plant or touch-me-not, is a creeping perennial herb recognized for its distinctive leaf movements in reaction to touch or vibration. It normally reaches a height of 30-60 cm and has a spreading habit with slender, branching stems. The leaves are bipinnately complex, with multiple little leaflets that fold inward and droop when touched or agitated, acting as a defense against herbivores. The plant produces small, fluffy pink or purple blooms that form globular clusters.

*46. Ricinus communis*

Ricinus communis, sometimes known as the castor oil plant, is a fast-growing, semi-woody shrub or small tree that can reach a height of 2-6 meters. It is distinguished by its huge palmate leaves, which have 5-11 strongly lobed, lanceolate leaflets. The leaves are glossy green with reddish veins and borders, creating a stunning look. The plant produces little greenish-yellow blooms in terminal panicles. The fruit is a spiny, spherical capsule with glossy, bean-like seeds that produce castor oil.

*47. Morus rubra*

Morus rubra, popularly known as red mulberry, is a deciduous tree that is native to eastern North America and also grows in India. It has a circular canopy, a short, crooked trunk, and grayish brown bark. The leaves are simple, alternating, and frequently lobed, having serrated edges and a gritty feel. The tree has little, greenish blooms that mature into scarlet to dark purple delicious fruits. The fruits are made up of many drupelets, similar to a blackberry. Red mulberry is widely grown for its sweet and juicy fruits, but it is also appreciated for its wood.

*48. Mimusops elengi*

*Mimusops elengi*, is a medium-sized evergreen tree . The tree has a dense, rounded canopy, a straight, slender trunk, and smooth, grayish-brown bark. The leaves are simple, alternating, and elliptic to oblong in form, with glossy green upper surfaces and pale undersides. The tree has small, white, fragrant blooms that grow singly or in clusters in the leaf axils. The fruits are oval, meaty drupes that turn green to yellow-orange when mature.

*49. Peltophorum pterocarpum*

Peltophorum pterocarpum is a medium or big deciduous tree. It features a spreading, umbrella-shaped canopy, a short, crooked trunk, and rough, grayish-brown bark. The leaves are bipinnate, alternating, fluffy, and include several tiny leaflets. The tree bears bright yellow, flowers present in dense, terminal clusters. The fruits are flat, woody pods that turn brown when mature and contain numerous seeds.

6.1 POLLEN MORPHOLOGY ANALYSIS

The exine sculpturing of pollen grains are studied under light microscope. One plant from a family is taken for this study.

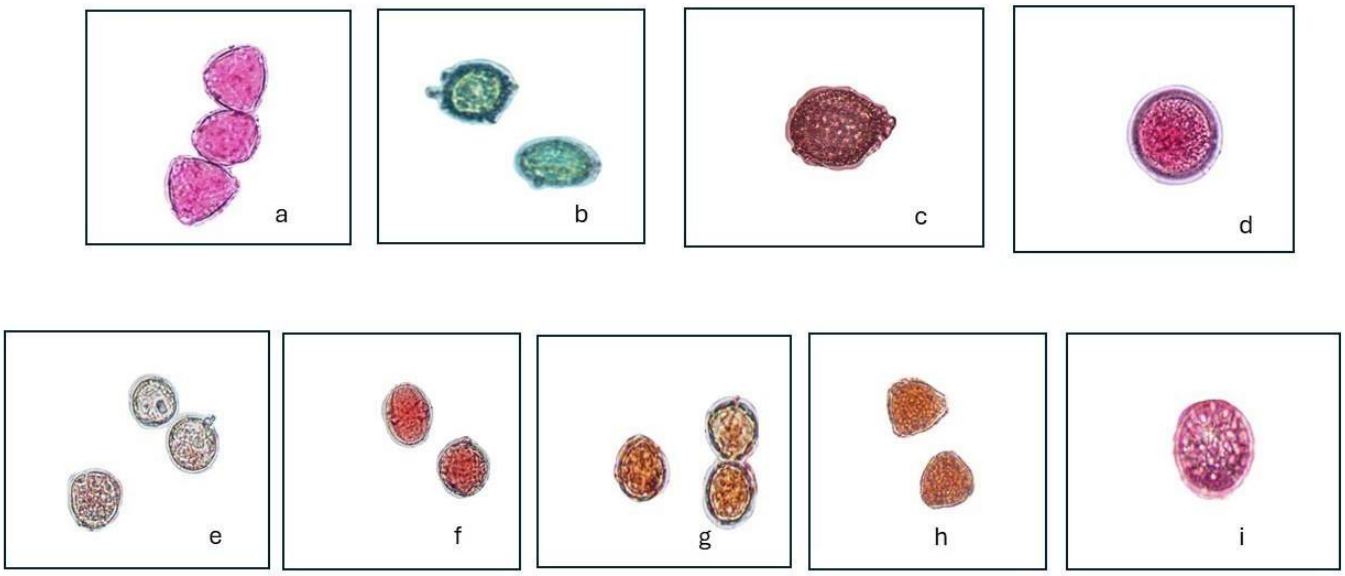



Image: 10

*Cassia fistula*

Cassia fistula (img a) pollen grains are subprolate, tricolporate, non-angular, colpi divided, exine thin, sexine thicker than nexine, and tectum reticulate-rugulate.Pollen grains of Cassia fistula from polluted industrial areas have some deposition, but there is no apparent evidence of exine reticulation (Kalkar Surekha et al., 2014).

*Myristica fragrans*

The outer exine layer of nutmeg (Myristica fragrans) (img b) pollen is distinguished by a pattern resembling a network or mesh, known as reticulate or muriate sculpturing (Sauquet et al., 2003).

*Peltophorum pterocarpum*

P. pterocarpum (img c) pollen is tricolporate in size, with an oblate spheroidal form and rounded AMB. Colpi are 37.5-40 µm long and wider at the center than at the ends. Each colpus has a margo with fine reticulations, and the ora is clearly defined and longitudinally elongated. The exine is 8-9 µm thick and coarsely reticulate, while the tectum is 3.2-3.5 µm thick and seems psilate on SEM. Infra tectal columellae

are 5.3--6.1 µm long, with a basal diameter of 1.0-1.2 µm with inflated apices (capita) of 3-5 µm. Smaller infratectal columellae are not seen between the major columellae. Lumina are 4-(8.4)-12 µm broad and have 7-13 smaller columellae compared to the two infratectal kinds. Muri are 1.9-(2.0)-2.3µm thick, with a simple cell structure (Orijemie et al., 2018).

*Pennisetum polystachion*

Pennisetum (img d) pollen grains are highly thick and practically free of micro channels and columellae (Fu et al., 2001).

*Ricinus communis* (img e)

Aperture: Tricolporate (C3P3), zonocolporate, with colpi that are not clearly distinguishable and as long as the P axes. Pori is equatorially elongated.Pore is rectangular. Amb circular, or transversally elliptic. Exine is rather thin (0.97). Exine is thinner than sexine, while sexine is finely reticulate, with a psilate tectum.Total exine thickness is 0.97 µm (0.8-1.1 µm). Sexine measures 0.68 µm (0.5-0.7 µm). Nexine measures 0.29 µm (0.2-0.4 µm). Sculpture: Scabrate (constructed of scabrae).Form and Symmetry: isopolar, radially symmetric. Shape classification: prolate spheroidal to subprolate. Grain medium size (Paul et al., 2014).

*Mimusops elengi*

Mimusops elengi L.: (img f) Monad, tetra colporate, prolate, 40.0-42.5 x 35-40 µm in length and breadth; amb quandrangular; colpi longicolpate, 25.0-27.5 x 5.0-7.5 µm in length and breadth; pori lalongate, 5.00-6.26 x 7.50-7.75 µm in length and breadth; exine 1.5-2.0 µm thick, exine as thick as nexine; sculpturing psilate (Maw et al., 2020).

*Mangifera indica* (img g)

Ultra structural examination revealed anther surfaces with polygonal cells and hollow centers grouped in a reticulate pattern, as well as swelling cells around the borders of the anther surfaces. Anther dehiscence occurs longitudinally, with pollen discharged through a large slit in both thecae (Muniraja et al., 2020).

*Amaranthus spinosis* (img h)

The exine of Amaranthus seed pollen usually has a linear or wrinkled sculpturing pattern known as striate or rugulate morphology (Majeed et al., 2023).

*Kyllinga brevifolia* (img i)

Kyllinga pollen features an exine with a sculpturing pattern similar to a network or mesh, known as reticulate or muriate morphology (Selamoglu et al., 2022).

## 6.2 ABUNDANCE AND DIVERSITY

The anemophilous plants in all study area are studied to evaluate the abundance and diversity. The anemophilous plants present all plants are of herbs and trees only. Anemophilic shrubs are not seen in study area.

### ABUNDANCE OF HERBS

Herbs are in large number and also ,most of them are flowered during study period. Eloor posses large number of herbaceous anemophilic plants. Nearly 24 types of herbs are there in Eloor Municipitality which anemophilic. 27 trees which are anemophilic in nature are also observed (Fig. 91)

*Pennisetum polystachion* is the most abundant plant in all study area. *Cocos nucifera, Mangifera indica, Areca catechu* are most common trees in tree types (Fig. 92) Apart from *Pennisetum polystachion* , there are also some other plants are present with high abundance. Some of them are, *Amaranthus spinosis, Eleusine indica, Kyllinga brevifolius, Micania micrantha.*

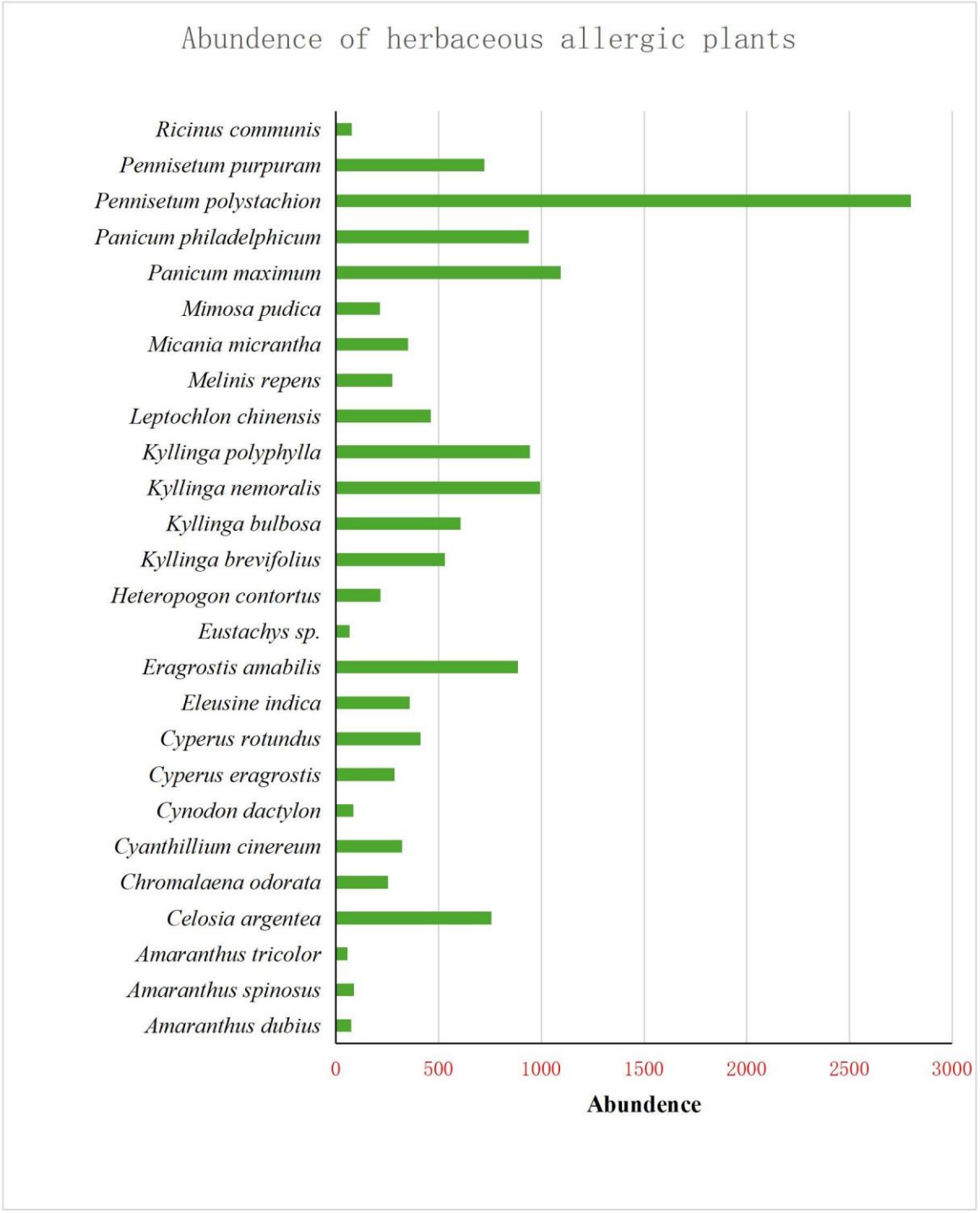

Abundence of herbaceous allergic plants
Ricinus communis
Pennisetum purpuram
Pennisetum polystachion
Panicum philadelphicum
Panicum maximum
Mimosa pudica
Micania micrantha
Melinis repens
Leptochlon chinensis
Kyllinga polyphylla
Kyllinga nemoralis
Kyllinga bulbosa
Kyllinga brevifolius
Heteropogon contortus
Eustachys sp.
Eragrostis amabilis
Eleusine indica
Cyperus rotundus
Cyperus eragrostis
Cynodon dactylon
Cyanthillium cinereum
Chromalaena odorata
Celosia argentea
Amaranthus tricolor
Amaranthus spinosus
Amaranthus dubius
0
500
1000
1500
2000
2500
3000
Abundence

Image: 12

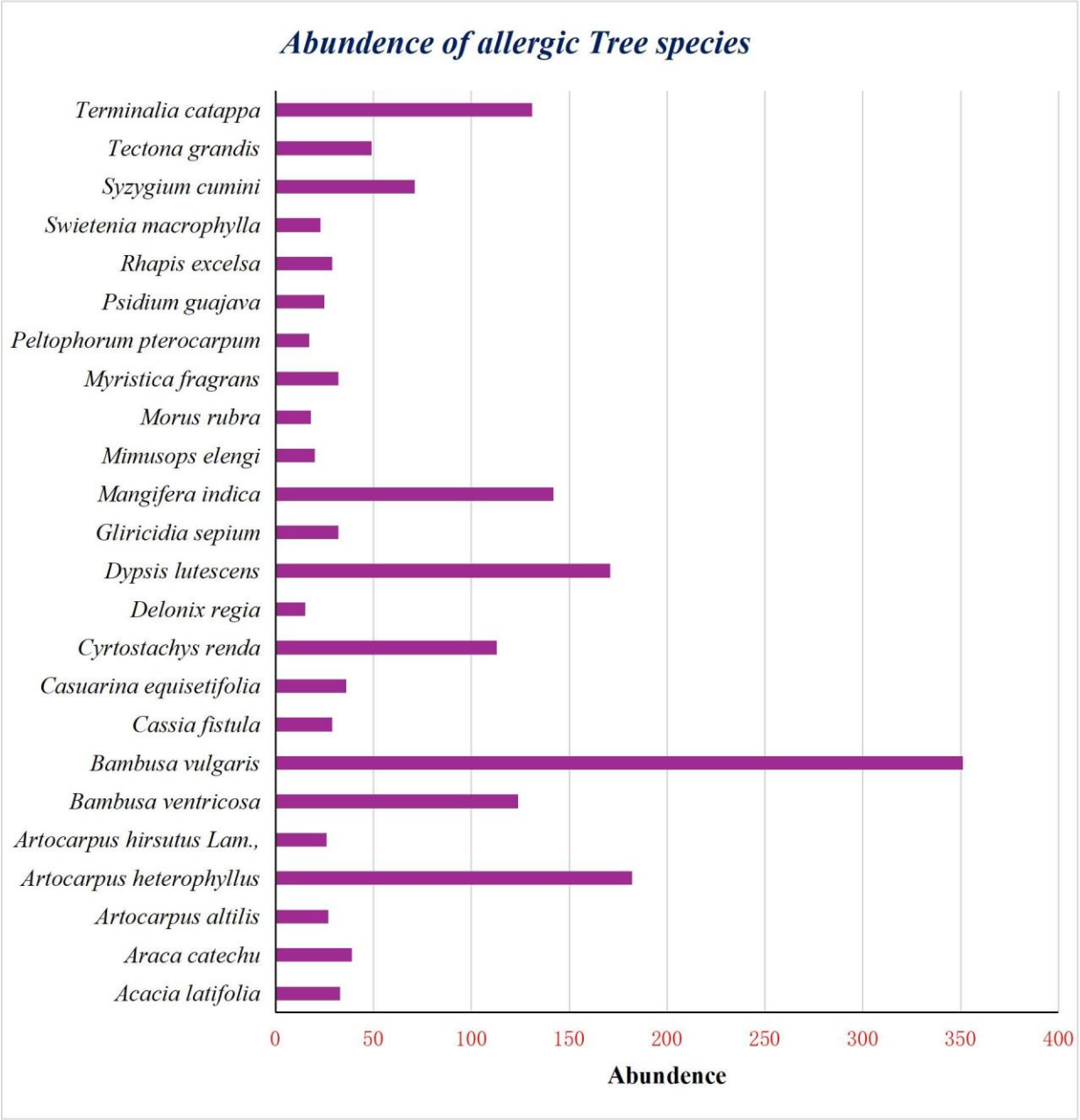

Abundence of allergic Tree species
Terminalia catappa
Tectona grandis
Syzygium cumini
Swietenia macrophylla
Rhapis excelsa
Psidium guajava
Peltophorum pterocarpum
Myristica fragrans
Morus rubra
Mimusops elengi
Mangifera indica
Gliricidia sepium
Dypsis lutescens
Delonix regia
Cyrtostachys renda
Casuarina equisetifolia
Cassia fistula
Bambusa vulgaris
Bambusa ventricosa
Artocarpus hirsutus Lam.,
Artocarpus heterophyllus
Artocarpus altilis
Araca catechu
Acacia latifolia
0
50
100
150
200
250
300
350
400
Abundence

Image: 13

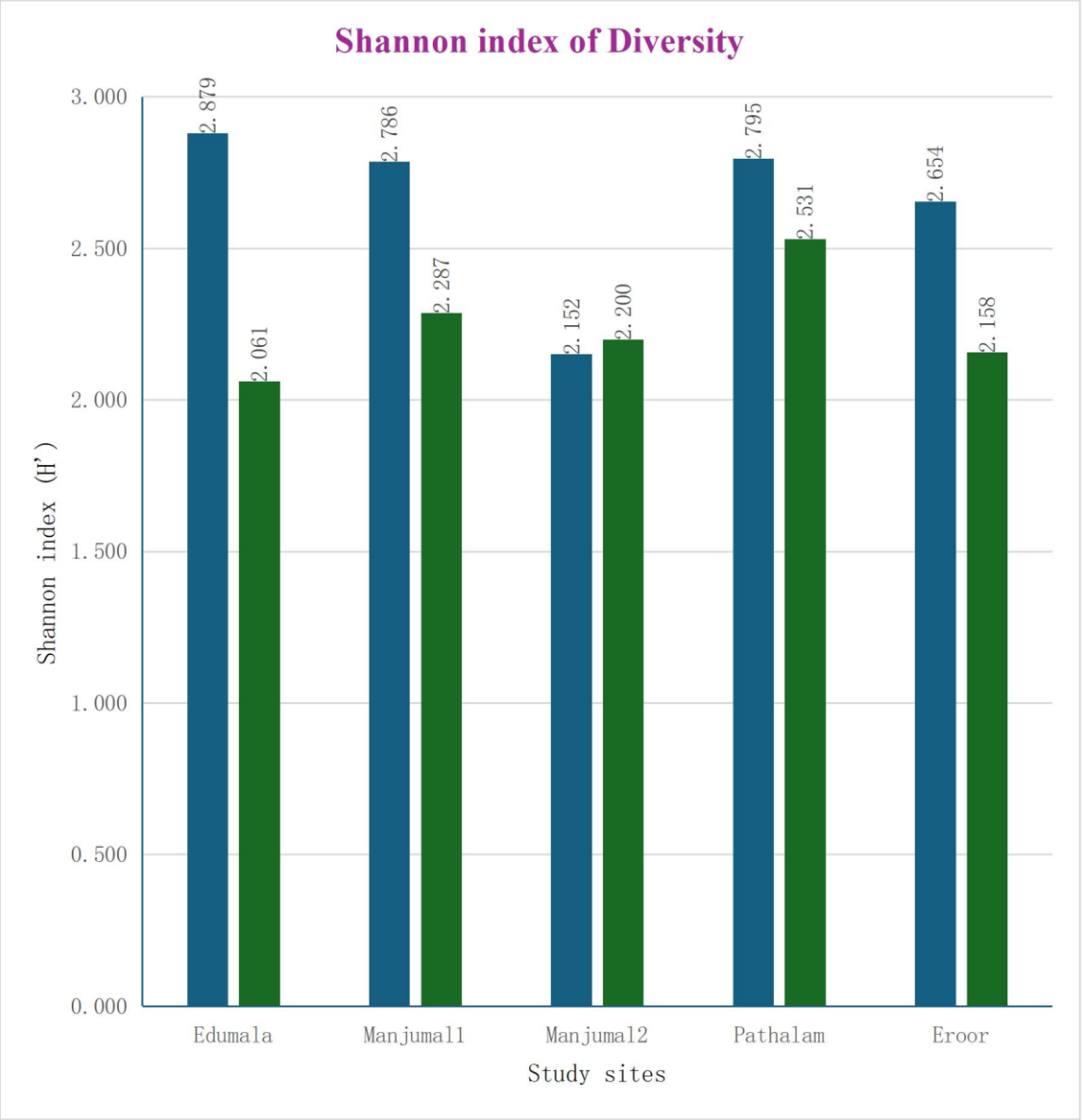

Shannon index of Diversity
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Shannon index (H')
2.879
2.061
2.786
2.287
2.152
2.200
2.795
2.531
2.654
2.158
Edumala
Manjumal1
Manjumal2
Pathalam
Eroor
Study sites

Image: 14

6.3 PHYSICO – CHEMICAL PARAMETER

All five research areas are analyzed using physical and chemical characteristics such a s wind speed, humidity, cloud cover, temperature, and precipitation.

EDAMULA


Image: 15

The graph shows the mean values of temperature and precipitation (FIG a) in Edamula during the study period December 2023 to March 2024. The temperature slowly increased by March and the lowest temperature reported during January. The precipitation also decreased by March , the lowest precipitation reported on February.The humidity (Fig b) falls after December . The last weeks of December is considered as fallen period of humidity.The wind speed (Fig c) also dropped out by March. The lowest wind speed

reported in January.The cloud cover (Fig d) remains same from December to mid January, After that we can observe a sudden change in cloud cover during February and by March it gets back to normal.

ELOOR HEALTH CENTRE / ELOOR WEST

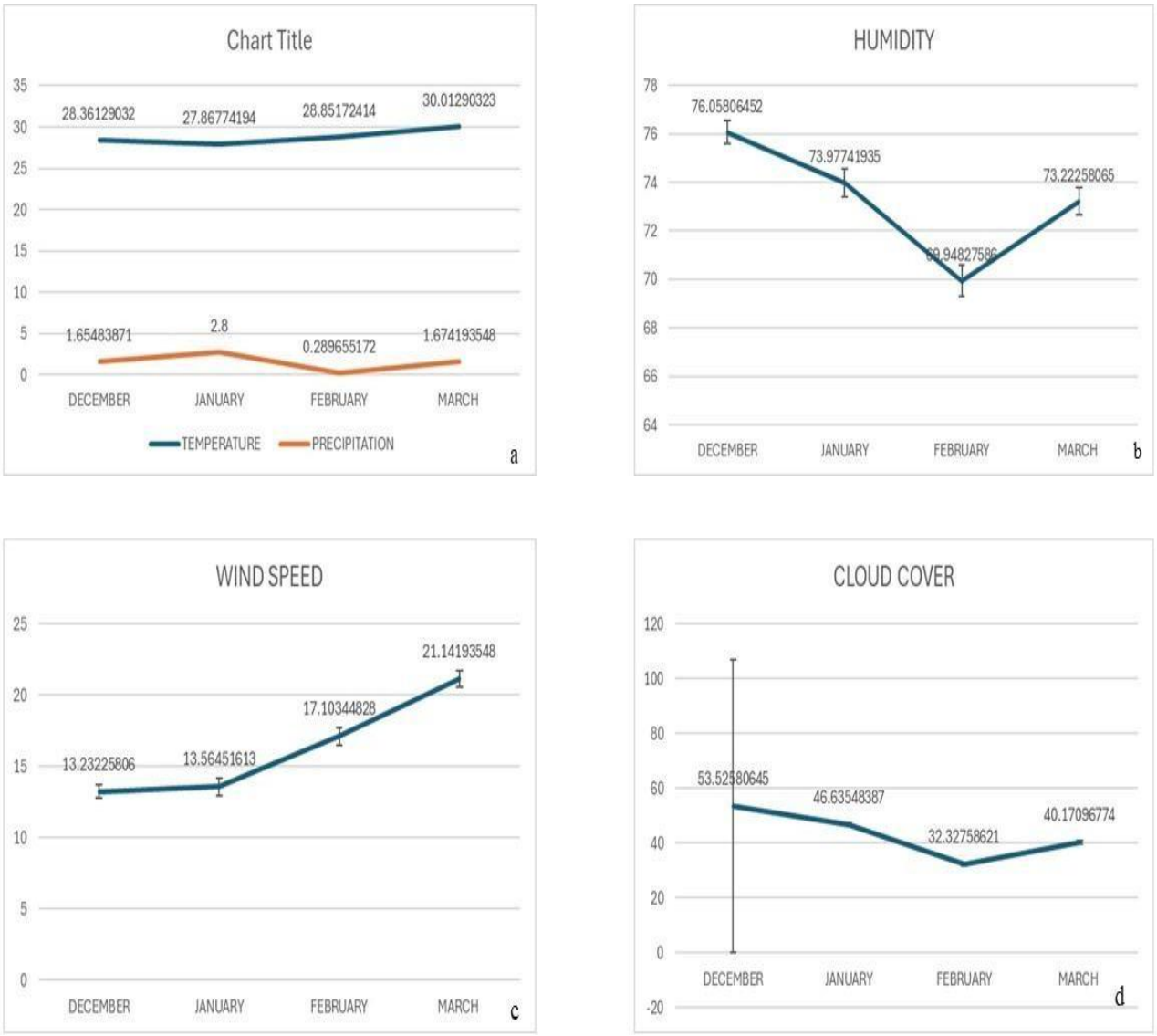



Image: 16

The above diagram (fig a) shows the mean values of temperature and precipitation during the study period . We can see that temperature is gradually increased by March but still the lowest temperature reported in February.The humidity (fig b) falling by March, but still the lowest humidity reported in February.The wind speed (fig c) increased by March. During December to January the wind speed is almost constant, after the we can see gradual increment in wind speed towards March.The lowest cloud cover (fig d) reported on February, after that gradual change of increment occurs by March.

PATHALAM

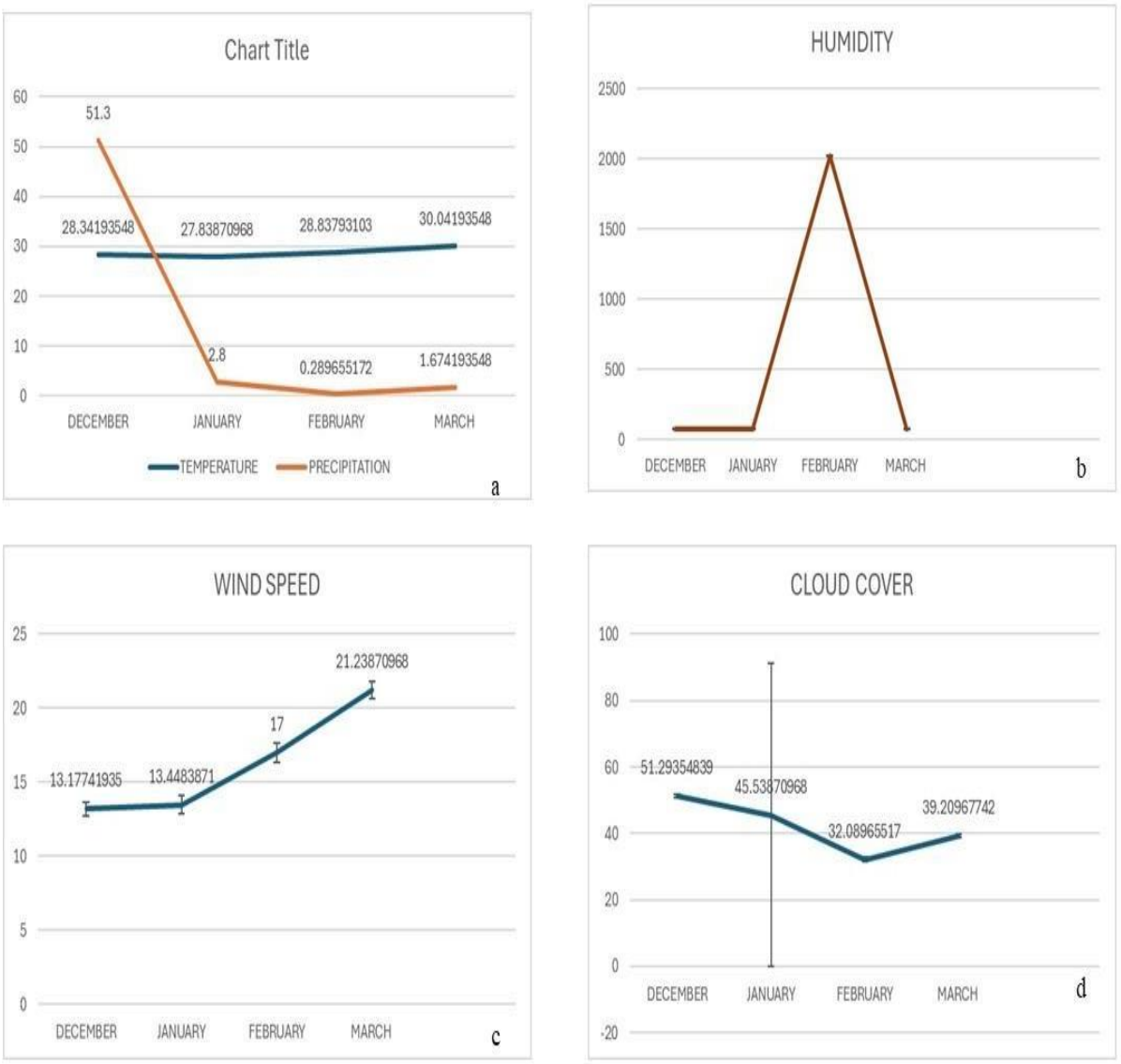
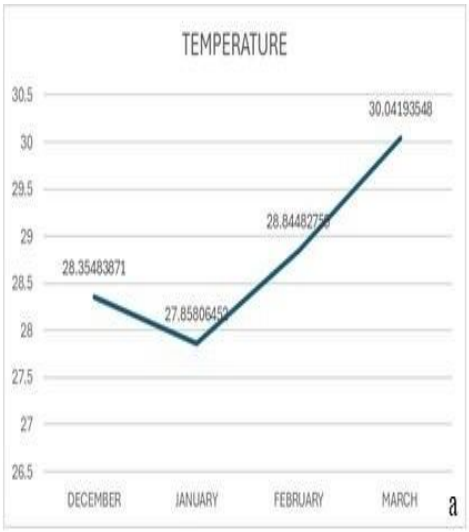
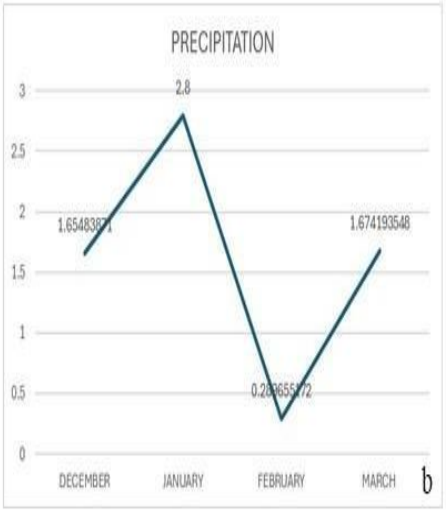
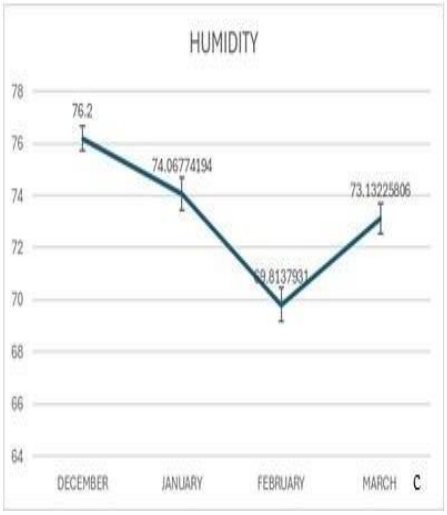


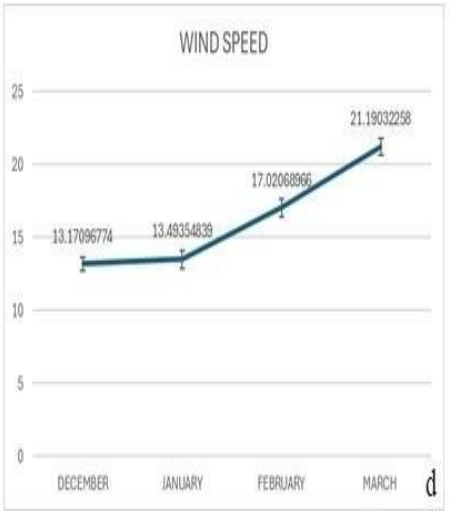

Image: 17

The above graph (fig a) shows the mean values of temperature and precipitation during study time. In case of temperature we can see a gradual increment towards March. The precipitation is rapidly fall down from December to January. But still the lowest precipitation reported on February.We can see rapid increment in humidity (fig b) by January and also fall by February.The wind speed (fig c) remains same during first month and shows gradual increase by January. The most highest wind speed shows in March. The lowest cloud cover (fig d) reported in February ,after that we can see a gradual increase by the end of March.



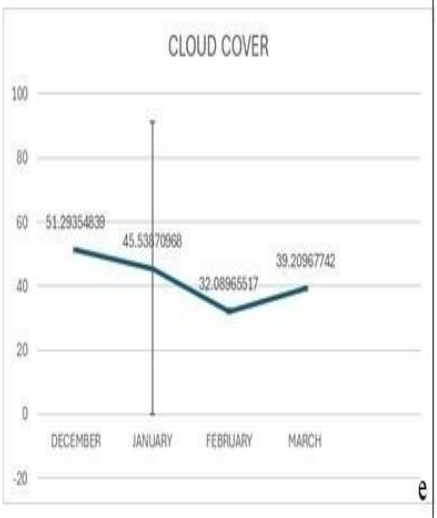




Image: 18

The graph above depicts the average temperature (fig a) and precipitation (fig b) during the study period. In terms of temperature, we should expect a gradual increase towards March. The lowest temperature reported January. Between December and January, precipitation increases quickly. January to mid February

considered as fallen period of precipitation. After February gradual increase in precipitation can be seen.However, the lowest precipitation was registered in February.The wind speed maintains its stability from December to January, after January the wind speed lost its stability and gradually increased by March.The humidity (fig c) varies by month to month .the highest humidity reported in December and lowest humidity reported in February.The cloud cover (fig d) was unsuitable through out the study period. From December to February observed a fall down cloud cover and from February onwards it was increased gradually.

MANJUMMEL MURUKAN TEMPLE

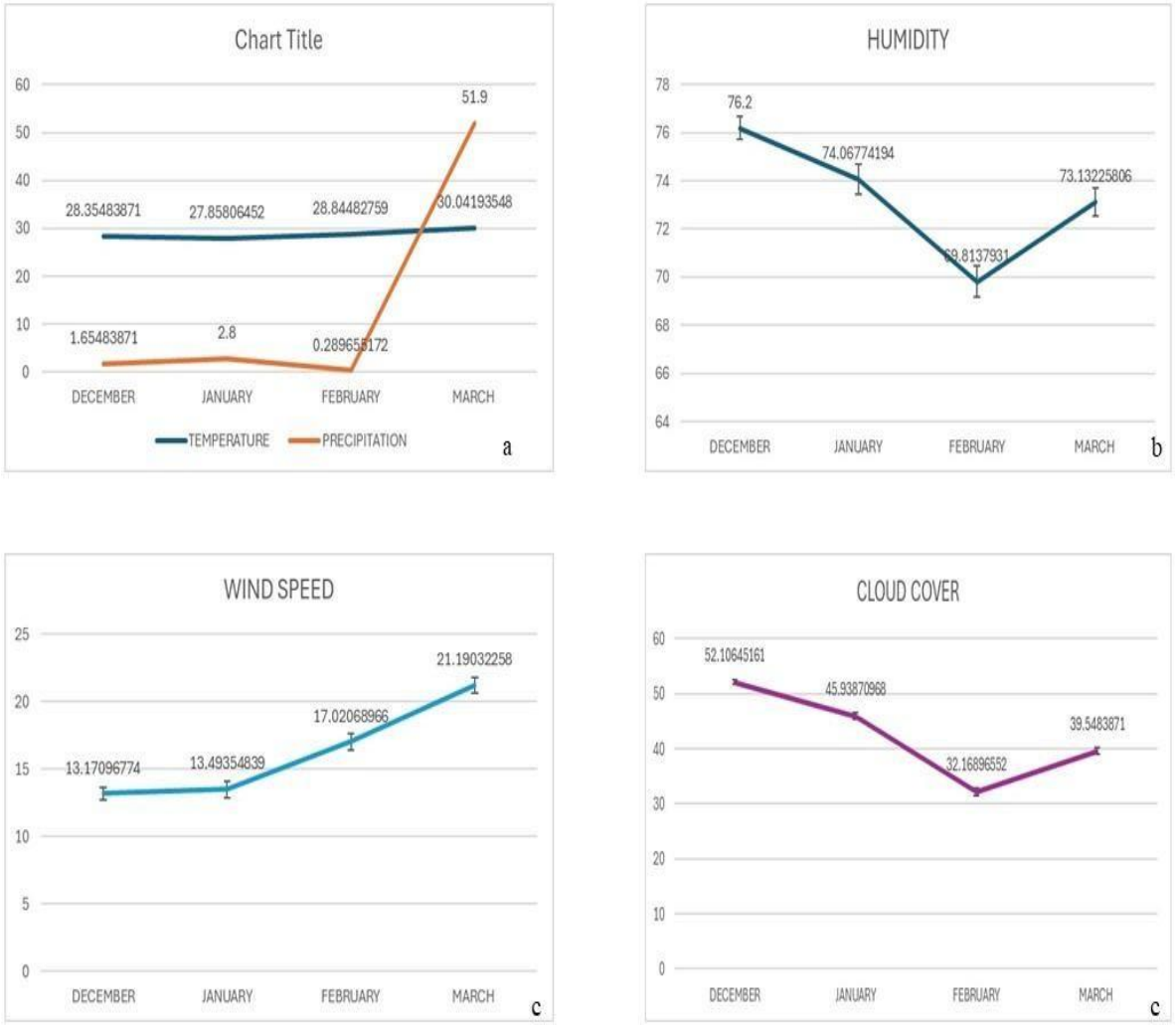



Image: 19

The above standard deviation of wind speed (fig a) shows gradual increase , January onwards. December shows the lowest wind speed value.The cloud cover (fig.b) falls gradually till February, later a slight increment seen by March.The above graph (fig c) shows the mean values of temperature and precipitation from December 2023 to March 2024. Temperature gradually grows towards March. The precipitation varies

slightly till February and after that we can see sudden increment in precipitation by March.The humidity (fig d) get decreased until February, the lowest humidity recorded in February and after February humidity slowly increased by March.

## 6.4 PUBLIC SURVEY ANALYSIS

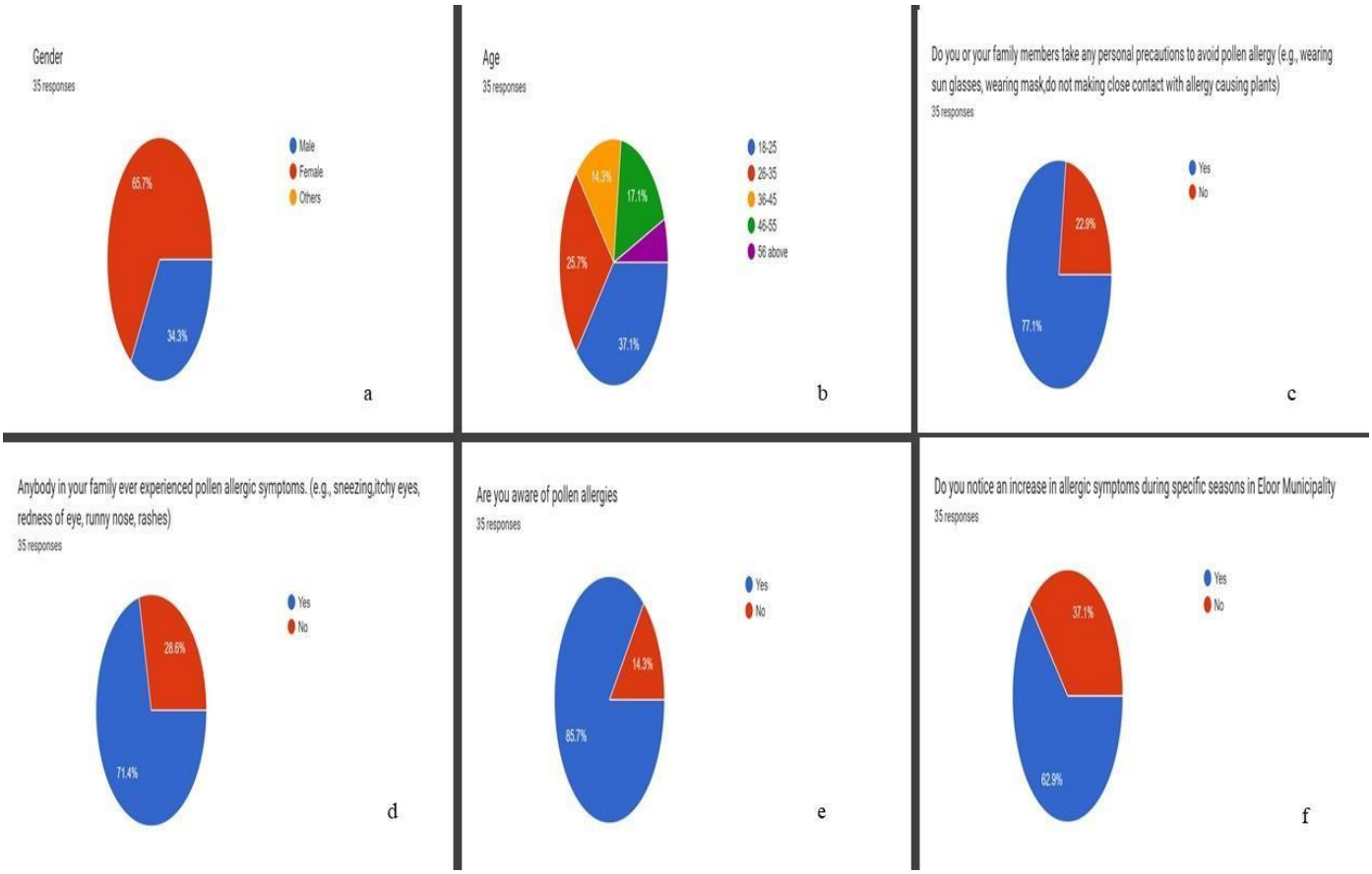



Image: 20

Age Group Distribution and Pollen Allergy Awareness (Fig b, Fig e) :

The age group between 18-25 are of 91.7% having pollen allergy awareness,75% of then have a family history and 80 % of them are taking precautions to prevent pollen allergy. The normal precautions taken by them are wearing sun glasses, avoid physical contact, stay away from allergic plants, washing hands and face in between .

The age group between 26-35 are of 25.7 %, among them 88.9% are having pollen allergy awareness.66.7% are having family history of pollen allergy and 66.7 % are of them taking precautions to avoid pollen allergy.

Age group between 36-45 are of 14.3%. 80% are having family history of pollen allergy and 100% of them having pollen allergy awareness and 60 % of them are taking precautions to avoid pollen allergy.

Age group between 46-55 are of 14.3%. 66.7% are having family history of pollen allergy and 83.3% of them having pollen allergy awareness and 66.7 % of them are taking precautions to avoid pollen allergy.

The age group above 56 years, among them 100% are having pollen allergy awareness.100% are having family history of pollen allergy and 50 % are of them taking precautions to avoid pollen allergy

The 36-45 and 56+ age groups are the most aware of pollen allergies, both at 100%, with 18-25 year old are close behind at 91.7%. The 18-25 age group takes the most precautions against pollen allergies at 80%, followed by 36-45 and 46-55 age groups, both at 66.7%. The 56+ age group has the most family members with pollen allergies at 100%, followed by 36-45 year old are at 80%(fig 84, fig 85).

Gender Distribution and Pollen Allergy Awareness ( Fig a, Fig e):

Both women and men are pretty clued in about pollen allergies, with 86.7% of women and 91.7% of men aware. More men (83.3%) have family members with pollen allergies than women (68.2%). Women are a bit more likely to take steps to avoid pollen allergies, with 75.0% taking precautions compared to 83.3% of men ( Fig h, Fig i)

Seasonal Variation in Pollen Allergy(Fig f)

Most people (62.9%) say their pollen allergy symptoms get worse in the summer. People who know about pollen allergies (87.1%) are more likely to say their symptoms get worse than those who don't know (12.9%). Out of those whose symptoms worsen in the summer, 74.2% are doing things to protect themselves from pollen.

## 7.00 DISCUSSION

All of the study area possess shows an inclined increase in temperature towards March. K.A. Engebretsen reported (Engebretsen et al., 2016) that when temperature increases the humidity decreases. So that during the summer season the the dispersal of unwanted pollutants may increase which results in allergic reactions like breathing difficulty , red eyes, rashes etc. Since pollen is a powdery substance (Soares et al., 2022) the possibility of spreading of pollen grains and causion of pollen allergy will increase, especially during March (Ito et al., 2015). This analysis clearly explains us that, during December and January the Temperature will be comparatively lower so the possibility to spreading of pollen grains , and pollen allergy caution. The amount of carbon di oxide also increase with air pollution. The increase in carbon di oxide results in establishment of pollen allergy more faster.

The end of the February to March, the wind speed also influence the distribution of pollen grains. If the wind speed is higher , the possibilities of pollen distribution and pollen allergy caution also increases. The humidity and Temperature are inversely proportional ,The humidity will increase when temperature low, and vice versa. The higher humidity rate will not allow the pollen to spread by wind. And also humidity depends on precipitations and cloud cover. These two factors will increase the rate of humidity.

Climate change may have an impact on seasonal allergic illnesses due to prolonged pollen seasons, increasing both allergic sensitization and symptom prevalence with severity (Choi et al., 2021). Millions of individuals suffer from seasonal allergies caused by airborne pollen, not just in the spring but also in the summer and fall, and new research predicts that their numbers will increase as the climate changes (Schmidt et al., 2016). Children with allergies are more likely to become sensitized to allergenic pollens in response to environmental changes (Lee et al., 2021). There are two ways to describe a pollen season: (1) designating a percentage of the annual or seasonal pollen index as start and end day, or (2) defining a given threshold (a specific daily pollen concentration with or without a certain amount over a defined period) as start and end day (Bastl et al., 2018). Recent research has shown that higher levels of carbon dioxide and warmer temperatures promote the establishment of allergenic plants. This also contributes to increased pollen production and the emergence of allergenic species in new climatic regions (Barnes et al., 2018). Variations in seasonal climate did have an effect on pollen counts and pollen release time, however this differed by taxon. Generally, warmer spring temperatures were linked to earlier pollen release (Manangan et al., 2021). Allergy rhinitis caused by pollen allergens is becoming more common among populations around the world (Šaulienė et al., 2016).

The Shannon diversity indices represent the diversity of herbaceous and tree species in the research region. Locations with greater tree diversity indices, such as Pathalam and Manjummel, as well as higher herbaceous diversity in Ernakulam South and Kaloor South, may have a wider range of allergenic plant species, potentially increasing the risk of pollen allergies. Because of their prolific pollen production and allergenicity, abundant species can have a substantial impact on pollen allergy prevalence. Plant richness and diversity studies in plants were conducted using the Shannon index by(Motz et al., 2010, Bernholt et al., 2009)

From the fig 91 and fig 92 we can see that pollen allergy causing anemophilic plants are seen in higher abundance in all study area. The presence of anemophilic plants in high abundance also promotes the distribution of pollen and pollen allergy. The air pollution may severely reflect and enhance the pollen allergy (Ravindra et al., 2022). Eloor is considered as most industrially polluted area in Kerala (Lekshmi et al., 2020). The most abundant anemophilic herbs are *Pennisetum polystachion, Pennisetum purpuram,*

*Panicum philadelphicum,Kyllinga polyphylla, Eragrostis amabilis* and *Chromalaena odorata*. The most abundant anemophilic trees are *Bambusa vulgaris, Psidium guajava, Artocarpus latifolia, Gliricidia sepium.*

The pollen characters such as small size, high number apertures, presence of uneven exine are observed under light microscope. These are the characters of typical pollen allergy causing pollens (Pointner et al., 2020).

From the survey reports, conducted in residence with google form explains that over 78% people are having family history of pollen allergy. And 64 % of them are taking precautions to rid of pollen allergies. And 48% of them are observed higher rate of pollen allergy caution during summer when temperature is high and also during air pollution. 85.7% are really concerned and aware of pollen allergy. These all factors may influence pollen allergy badly.The findings from personal interviews emphasize the necessity of studying pollen allergy prevalence and its influence on the local community. By identifying peak allergy seasons and common preventative actions, healthcare providers and governments can create focused initiatives to help people with pollen allergies.

## 8.00 CONCLUSION

The present study was aimed at developing a knowledge about pollen allergy and how much possibilities are there to spread pollen allergy during late north east monsoon and pre monsoon. By this research we got the diversity of pollen allergy causing plants in Eloor Municipality. How much abundance they poses during each month from December 2023 to March 2024. Since Eloor is a place were highly industrialized, High rate of air pollution also can be observed. This polluted atmosphere is enhancing the spreading of pollen allergy. And especially during summer, the rate of anemophilic pollen production, and the spread of pollen allergy observed more densely. The climatic conditions in March like, high atmospheric temperature, low precipitation, low cloud cover are favourable conditions for pollen allergy. From the public survey we came to know that more than 65% people in Eloor having pollen allergic symptoms. And also most of them are having a family history of pollen allergy too. Anemophilic herbs and trees are can be seen in entire area of Eloor Municipality, but anemophilic shrubs are almost absent. Poacea is a family provides largest varieties of plants which causing pollen allergy. These type of grass varieties can be grown even in drought soil. By this study I developed a basement works to create pollen calender.

The persons who are suffering from pollen allergy are better to be stay away from pollen allergy causing plants, wear sun glasses to avoid the contact with pollen and naked eyes. Wash hands and eyes when ever went near by allergic plants, wear face mask to avoid respiratory issues like breathing difficulty, sneezing etc. Consult a doctor when ever the allergy exceeds its limit. And spread awareness about pollen allergy by sharing the precautions method with your friends and family.

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