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# FLUCTUATION OF GROUNDWATER LEVEL AND ITS IMPACTS IN CERTAIN PARTS OF CHENNAI

G Srinivasan\* and A Abirami\*

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## Abstract

*Chennai, Kanchipuram and Tiruvallur region experiences a semi-arid climate with fluctuating levels of annual normal rainfall. The altitudes of land surface are from 10 m above mean sea level in the west to sea level in the east. The whole of the Chennai city except Guindy National Park and IIT is dotted with built up area with large scale human activities that has resulted in all types of pollution. Water table increasing during the monsoon and decreasing during summer has become routine in almost all parts of the city. The predominant water levels are in the range of 5 – 20 m below ground level during the pre-monsoon period and 2 – 10 m below ground level during the post-monsoon periods. The most common reasons for fluctuations of groundwater are monsoon failure, excessive extraction of groundwater in several zones, extreme heat waves during summer and illegal mining of groundwater. Other issues are low sustainability, steady salt water ingress, indiscriminate groundwater mining, contamination of groundwater due to landfill sites, industrial pollutants, surge in urbanization etc. The Chennai city requires almost 1300 million litres per day (MLD) of water. There are laws for optimal utilization of groundwater, but stringent enforcement is still not in place to save the groundwater from illegal mining. Fluctuation of groundwater is not new to Chennai. There have been instances of rise of water level at the rate of 0.002 to 0.09 m/year and fall of water level ranges between 0.03 to 0.8 m/year. Groundwater recharge, maintenance and development are related to the water supply position to the actual water available. In Chennai, dug wells, filter point wells, tube wells and bore wells are the most common extraction processes followed. The current review is a short study of fluctuation of groundwater and measures adopted by authorities to conserve groundwater.*

**Keywords:** water table level, fluctuation of groundwater level, groundwater extraction, unpredictable monsoon, water quality.

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## Introduction

Among the available freshwater sources, groundwater is the most important one, as it caters the demands of domestic and industrial sectors. In Chennai, every year after the northeast monsoon (roughly from October to December), there is a slight surge in the level of groundwater; also the water reservoirs that caters to the city brims with full capacity. Yet, during summer there is acute water shortage as the groundwater level dwindles to its bottom. In recent years, the groundwater level and the low sustainability, sea water ingress (Rajaveni *et al.*, 2016), groundwater contamination, faster urbanization, low yielding aquifer units are a few issues that plague the city. Studies have shown that monsoonal changes, geogenic and anthropogenic influences have impact on groundwater chemistry (Balasubramanian *et al.*, 2021, Subba Rao, 2006). Also, there is considerable change in the physicochemical parameters such as pH, electrical conductivity, Total Dissolved Solids, Total Hardness, anions and cations, both during pre-monsoon and post-monsoon seasons. There are fluctuations in the water levels in the urban areas. In

Chennai, within weeks of northeast monsoon, the groundwater level depletes. This is due to continuous extraction process to cater the needs of the dense population. The nearby Kanchipuram district is classified into coastal areas and other plain lands with intermittent hills. River Palar with its tributaries – Cheyyar and Vegavathi caters the needs of Kanchipuram and suburbs of Chennai. Apart from these facts, during the Covid-19 induced nation-wide lockdown, urbanized coastal cities have reported improvement in surface water quality and reduction in industrial, domestic and agricultural sewage to the coastal ecosystem (South Asia Network on Dams, 2020, Yunus *et al.*, 2020, Somani *et al.*, 2020 and Robin *et al.*, 2021).

In terms of consumption, Chennai's per capita consumption at 107 litres per capita per day is low when compared with other cities and the rainfall in 2018 had been at the lowest at 75.55 cm (Narasimhan and Babu, 2019). The following table shows the groundwater level (in m) observation wells in few districts in and around Chennai (from 2018 – 2020). Lower the level in metres, better the groundwater.

District	2018	2019	2020
Chennai	6.29	7.81	6.68
Tiruvallur	6.12	6.47	5.79
Kanchipuram	4.51	6.08	4.92
Tiruvannamalai	7.39	10.83	7.83
Vellore	7.99	11.12	9.42
Villupuram	8.09	9.49	9.11

Several studies have been carried out to assess the quality and quantity of groundwater in and around Chennai; studies on seawater intrusion, declining of groundwater level, increase of hardness, Na/Cl ratio, Cl/HCO<sub>3</sub><sup>-</sup> ratio, Ca/Mg ratio and Ca/Na ratio (Annapoorani *et al.*, 2014), detection of microplastics and heavy metals etc. Ramachandran *et al.*, (2020) studied the Adyar River Basin for identification of groundwater zones with samples of groundwater during pre-monsoon and post-monsoon seasons for four years and analyzed their physicochemical parameters and with spatial distribution maps; the study reported that around 10 – 17% of the study area was within the excellent water quality for drinking purpose and almost 42% was found as poor quality groundwater for drinking purpose. According to a report published in Nature, climate change has a direct influence on coastal economies and sea levels have risen at about 2.5 mm a year globally in the last 20 years along with increased extraction of groundwater. This has to be cut down by policy makers with regulations in development and its impact in coastal cities (Deccan Chronicle, March 2021). In the last months of 2020, there was copious rainfall in Chennai, yet in the month of February 2021, groundwater level witnessed a dip. Paul and Elango (2018) studied a model - Water Evaluation and Planning Model (WEAP model) and reported that an increase in reliability of water supply by about 30% will be fulfilled by reusing wastewater and nearly 20% by new reservoir and 10% by the then-proposed desalination plant.

## **Average groundwater level in various areas of Chennai in 2020**

The following table shows the average groundwater level in various areas in Chennai, during the whole of 2020. The values shown here is the availability of groundwater in depth in metres. The areas mentioned from I to XV denote the various locations starting from north of Chennai to south of Chennai; for e.g., areas I to VI denotes Ennore, Ernavur, Tiruvottiyur, Manali, Puzhal, Madhavaram, Tondiarpet, Kodungaiyur, Royapuram, Parrys and Egmore. Areas VII and VIII covers the western parts such as Korattur, Anna Nagar, Mogappair, Chetpet, Arumbakkam, Anna Nagar, etc. Areas IX to XII cover eastern parts such as Royapettah, Mylapore, Koyambedu, Saidapet, Porur, Velachery and Nandambakkam. Areas XIII to XV cover southern parts such as Santhome, Taramani, Besant Nagar, Pallikaranai, Neelangerai, Thoraipakkam, Sholinganallur and Semmancheri. The areas covered are based on the different zones in Corporation of Chennai.

The table gives the groundwater level for the past five years in Chennai. When compared with the five years' data (2016 – 2020), naturally the groundwater level is dwindling due to continuous extraction. Rainfall is usual with an exception of 2015, in which during the northeast monsoon season, clouds were stationary over Chennai (upstream blocking) as reported by Phadtare (2018).

Year	Average groundwater level in 2020 (in metres)			
	January – March	April – June	July – September	October - December
2016	2.16	3.20	3.45	3.58
2017	3.44	4.99	5.20	3.54
2018	4.31	5.9	5.7	4.76
2019*	6.03	5.36	5.35	1.53
2020	5.03	6.4	5.19	2.87

(Source: CMWSSB website) (\*- water level of Teynampet alone)

In the month of October to December, the groundwater level is higher which is attributed to the North-East monsoon and in the months of April to June, the level dips due to the summer.

Areas	Average Groundwater level (in metres) in 2020			
	January – March	April – June	July – September	October - December
Area I	4.58	5.37	4.8	3.63
Area II	4.1	5.33	4.32	2.75
Area III	5.34	6.67	5.76	3.87
Area IV	5.97	6.81	6.49	5.22
Area V	6.55	7.29	6.68	5.32
Area VI	5.21	7.73	6.38	3.43
Area VII	5.52	8.02	6.93	4.26
Area VIII	4.43	6.05	4.75	2.66
Area IX	5.19	6.07	4.85	3.23
Area X	6.13	7.29	5.25	3.94
Area XI	6.25	6.93	5.71	3.33
Area XII	4.73	6.58	4.74	2.86
Area XIII	4.60	5.76	4.26	2.5
Area XIV	3.77	5.87	4.03	2.75
Area XV	3.09	4.27	2.92	1.92

(Source: CMWSSB website)

From the above table, it is evident that groundwater is readily available in lesser depths (in metres), i.e., 2 – 4 metres in the months of November and December during the monsoon season. During the pre-monsoon period, i.e., from July to October, the availability is around 4 – 6 metres. Also during the

post-monsoon period and summer, the availability dwindles further to around 7 metres. In southern areas such as Tiruvanmiyur, Velachery, Pallikaranai and in northern areas of Manali and Ennore, there is severe salt water intrusion, which adds to the water shortage problem.

Month	Groundwater level (in m)
January	4.78
February	5.29
March	N.A.
April	N.A.
May	6.12
June	6.69
July	5.21
August	5.30
September	5.07
October	2.96
November	2.98
December	2.69

The table shows the average groundwater availability in all the 15 zones altogether throughout the year 2020.

The following table shows the level of groundwater in late 2020 and early 2021. From the table, it is clear that there is a dip in the level in January – February 2021.

Location	Groundwater level (Depth at which water was found (in m))		
	November 2020	December 2020	January 2021
Teynampet	2.74	2.52	3.40
Adyar	2.01	1.47	2.34
Tiruvottiyur	3.28	3.13	3.92
Tondiarpet	4.81	4.67	5.18
Royapuram	4.89	4.64	5.24
Kodambakkam	3.69	3.11	3.53
Alandur	2.3	1.83	2.43
<b>Average</b>	<b>3.38</b>	<b>3.05</b>	<b>3.72</b>

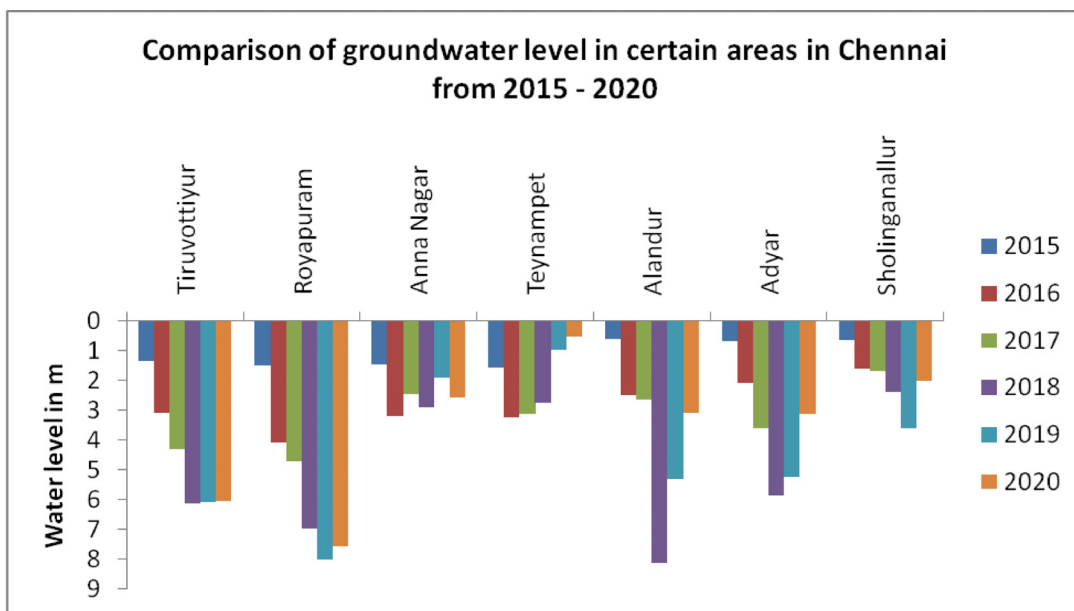
(Source: The Times of India)



## Fluctuation in groundwater level

In areas of north Chennai, which is dotted with various factories – both private and state run – the groundwater is contaminated due to effluents. For e.g., the groundwater in Manali area is pale to light yellow in color for several years; this causes health issues and corrosion of materials, soil erosion and seawater contamination. There is continuous demand for closure / relocation of these industries as they not only cause health issues, but also harms the marine organisms. But, there is no strong response for rehabilitation of affected population and hence, they became accustomed to survive with the contaminated groundwater. In case of central Chennai, there is dense population – both floating and permanent – and hence to cater the needs, groundwater is extracted continuously. Day by day, newer commercial establishments, migrating population, construction

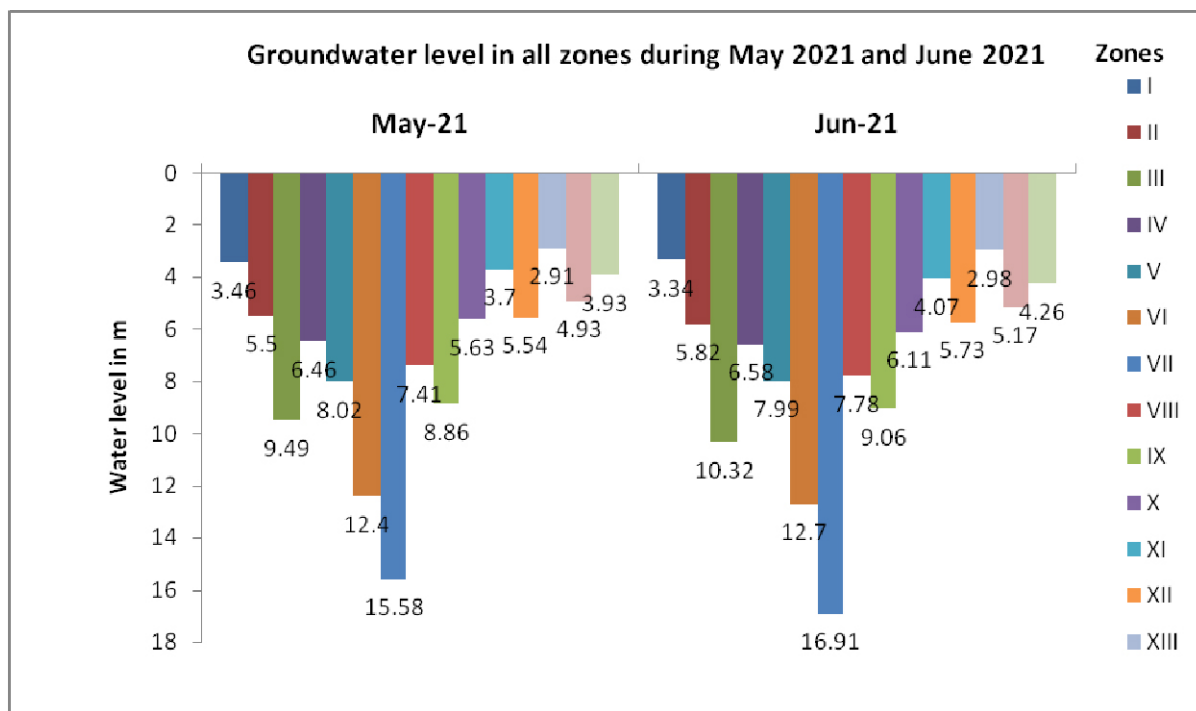
activities and domestic purpose arise and this leads to water shortage. Both in central and south Chennai, there are urban and rural settlements, which require water for domestic purposes. Although there are five to six reservoirs, there is steady increase in the number of water-laden tankers every day and in summer; the number of tankers are multifold. Before 2010, there was very little fluctuation of groundwater in areas of Tambaram to Chengalpattu. But, due to more and more emergence of IT firms, educational institutions and gated community ‘residential villages’ mushroomed around the area and now, it is struggling to provide water even before the month of March. In areas such as Pallavaram, Chromepet and Sanatorium the groundwater is contaminated with tannery effluent and the population around the Hasthinapuram (Chromepet) has become accustomed for several skin infections.



The graph shows the dwindling trend of groundwater in various areas of Chennai from 2015 to 2020. There is steady decrease in the water table each year. After the deluge in 2015, the groundwater level was moderate in 2016, which reduced further in 2017 and 2018. But this was not the same all over the city; the level reduced in northern parts of Chennai when compared with central parts and adjoining suburban areas. This graph is only a selected representation of groundwater level in certain areas out of the 15 zones in the city. The following graph shows a decline in the groundwater level in the months of May and June 2021.

Most parts of the city recorded a dip in the groundwater level in June when compared to May, except the zones of

Royapuram and Tiruvottiyur. This may be due to the fact that groundwater level recorded installed by CMWSSB is placed close to the beach and hence the level is high in those areas. For instance, the zone Madhavaram recorded a maximum dip in groundwater level of 0.83 m in the month of June. In areas such as Ambattur, where there is clayey soil, water has to be drawn from shallow aquifers during monsoon months and from deeper aquifers during the summer (The Times of India, July 2, 2021). In the month of July, the city and its suburbs experienced rainfall from Southwest monsoon, which resulted in considerable rise in the groundwater level. The following table shows the rainfall level in the month of July 2021 in various areas in and around the city.



July (random dates)	Rainfall in various areas (in mm)								
	I	II	III	IV	V	VI	VII	VIII	IX
I week	24	18	24	21	9.4	13	0	5.4	12.8
II week	8	0	0	0	3	0	0	0.4	1.5
III week	72	35	22	55	26	7	0	60.5	16.4
IV week	12	46	31	18	0	4	0	0.8	0

I – Poondi, II – Cholavaram, III – Red Hills, IV – Tamaraipakkam, V – Chembarambakkam, VI – Korattur anaicut, VII – Veeranam, VIII – Nungambakkam, IX - Meenambakkam

With the above rainfall (in mm), the groundwater must have been recharged. But, from the data obtained from the CMWSSB website, it shows that groundwater level in certain areas remained unchanged and if at all there is a rise, it is very little, which can be seen in the following table.

Zones	July 2021 (groundwater level in m)
Teynampet	3.186
Adyar	1.66
Tiruvottiyur	1.80
Tondiarpet	5.84
Royapuram	6.99
Kodambakkam	2.76
Alandur	2.21
Manali	2.12
Madhavaram	2.75
Thiru Vi Ka Nagar*	0.713
Ambattur	4.56
Anna Nagar	3.26
Valasaravakkam	3.9
Perungudi	4.47
Sholinganallur	5.81

\*In Thiru Vi Ka Nagar zone, groundwater level fluctuation was higher in various areas ranging from 0.71 m in Kolathur to 20.22 m in Mangalapuram (Jamalia).

## Impacts of excessive extraction of groundwater in Chennai

- ❖ Excessive pumping lowers the groundwater table and leads to abandonment of wells, which itself is a clear and open danger. In areas such as Velachery, Mambalam and Mylapore, where still there are traditional wells, people had to resort to compressor motor as the water table sinks to bottom every year. Also poor maintenance of open dug wells or improper implementation of groundwater harvesting can lead to depths of even up to 100 feet. after a poor monsoon.
- ❖ As the water table lowers, there is a need for pumping farther to reach the surface using more energy and more manpower. For e.g., many commercial establishments, residential complexes such as gated communities expect / demand 24 hours break-free water supply, for which bore wells are dug as deep as possible. There is very little to no pricing policy for groundwater users to control illegal extraction from lorries. The unused dug wells and bore wells can also be used as artificial recharge structures to recharge groundwater (Anonymous).
- ❖ When groundwater is overused, the surface water such as streams, lakes and rivers also deplete and leads to disappearance of such sources. When water bodies disappear, the site turns into construction activities. In 2021, the Southern Zone of the National Green Tribunal was informed that around 727 of the 1900 encroachments have been identified in Alapakkam lake alone on the city outskirts (Sundaram, 2021).
- ❖ Groundwater is needed for land subsidence. When it is over-exploited, the soil collapses and one day, everything compacts and drops. The percentage of over-exploitation / critical areas increases by year. Increasing the artificial recharge structures in areas may avoid depletion of groundwater.
- ❖ Change in quality of water – as the well is dug deeper – is due to the water acquiring the properties of subsoil layers. This leads to salty and metallic taste due to iron contamination; this leads to hair loss; skin problems as excess sweating create lesions and blisters. These higher levels of hardness are observed in water samples from Pallikaranai marshland, Madipakkam and Velachery areas. The following table shows the decline in water quality in certain areas in Chennai from 2017 to 2019.

Area	Total Dissolved Solids (mg/l)		
	2017	2018	2019
Mylapore	655	611	598
Mambalam	418	467	617
Royapettah	491	846	722
Maduravoyal	686	569	984
Adyar	1068	849	Well dry

(Source: The Hindu, 2019)

## **Initiatives for conservation of groundwater**

- ❖ A number of check dams and injection wells have been constructed to recharge ground water and to arrest saline water intrusion in well-field that is close to the coast (CMWSSB website). Construction of check dams across River Koratalaiyar and construction of injection wells in Minjur Panchetty aquifer are initiated. This may store the flood waters during the monsoon periods leading to recharge of groundwater.
- ❖ Government initiative: Based on continuous research and positive outcome, recharge wells, barriers and injection wells were constructed to monitor the quality of groundwater, possibility of seawater ingress and improvement in quality of groundwater. This also helped in maintaining optimum level of extraction of wellfields (CMWSSB website).
- ❖ In the rain water harvesting system, there is another technique - creation of a slope on the roof of a building that transports water through a hole that goes to a tank; this can be carried out after filtering using a cloth that collects the dust. This process can store huge quantity of water, based on the size of the sump constructed; also this recharges the groundwater significantly.
- ❖ As per the Chennai Metropolitan Area Groundwater (Regulation) Act, 1987, registration of existing wells, registration of sinking new wells, issue of licences to extract groundwater for non-domestic purposes and issue of transportation

through goods vehicles are mandatory (CMWSSB website).

- ❖ In a bid to mitigate seawater ingress, several storage structures are being constructed across Araniyar river near Pazhaverkadu. The barrage, which is a storage structure with regulator arrangements, is built to store additional amount of water. These structures would help to restore groundwater quality in Ponneri belt, where several villages depend on the river and waterbodies for cultivation and drinking water needs (The Hindu, 2021).
- ❖ Management is the key for water conservation. On an average, one household uses the flush at least 8 times per day in toilets (3 litres of water per flush). Recycling and reuse of flush water can be made compulsory so that water consumption can be reduced, especially in apartments, hotels, hospitals and other buildings (The Hindu, 2019).
- ❖ To prevent run-off of water into sea during monsoon, underground water storage structures can be constructed. This can store rain water, but also will prevent flooding during the monsoon.

In case of seawater intrusion issue, the CGWB conducts several Mass Awareness Programmes (MAP) and Water Management Training Programmes (WMTP) for awareness among the people to save coastal groundwater resources. In addition to that, several state governments have formulated water quality monitoring boards for the preservation of groundwater resources. Also individual researchers, activists and educational

institutions or organizations are monitoring the seawater intrusion from time to time (Prusty and Farooq, 2020).

## Conclusion

By nature, groundwater is a shared entity. Groundwater aquifers are shared by rural & urban dwellers, and small & medium scale industrial units. Even though there are several legislations such as CMWSSB Act, 1978, Chennai Metropolitan Area Groundwater (Regulation) Amendment Act, 2002 and Tamil Nadu Groundwater (Development and Management) Ordinance, 2003 to save the groundwater, water scarcity increases every year. But there are no legislations to prevent hogging of groundwater. Legislations fixing caps on construction activities, groundwater extraction and tapping of groundwater with double motors are the need of the hour. Minimizing the per capita consumption (except for drinking purpose) of water can conserve significant quantity. Chennai Metro Water is also continuously requesting the residents to use metro water for drinking and cooking purpose only. It is up to the citizens to ensure that the pipes and taps are leak proof, close the tap while not in use and to divert the bathroom / kitchen water to garden and plants; use of washed water to flush toilets etc. During the pre-monsoon period, apart from removal of water hyacinth and other plants and debris, desilting activities must be carried out in all the reservoirs. Also, groundwater bodies have a negligible rate of recharge. Hence it is our duty to propagate about the limited usage of the available water and conservation of

groundwater. Alternate sources can be explored for catering the growing population but it is the citizens' indifferent attitude that impedes the conservation of groundwater.

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# GRAIN STORAGE METHODS IN THANJAVUR AND KANCHIPURAM

J. Sumathi\*

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## Abstract

*In most countries grains are among the most important staple foods. However, they are produced on a seasonal basis, and in many places there is only one harvest a year, which itself may be subject to failure. Farmers use traditional storage containers for storing food grains for their own need. These storage structures are comparatively cheap, eco-friendly and impart high shelf life to the stored commodities. These traditional storage systems could be applied in modern storage areas with minor modification, could save food commodities that would be damaged by insects.*

**Keywords:** Grains, Grain storage methods, Traditional storage.

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## Introduction

Storing grains are one of the most notable traditional practices, which are emotionally and scientifically part of our culture. The technical knowledge and vision of our ancestors reflect through them. These are a striking expression of the importance of food and the extent to which it was carefully and respectfully preserved. A farmer's home can be easily identified by the spike of paddy (*Nerkatir*) hanging above the main door entrance<sup>1</sup>. In earlier days temples were also used as warehouses for storing grains and seeds, for use in times of famine. The grains were stored differently from one region to another in Tamil Nadu.

This research article is based on my field visits from two Districts Kanchipuram and Thanjavur<sup>2</sup>.

## Storage method in Thanjavur District

Thanjavur district stands unique from time immemorial for its agricultural activities and is rightly acclaimed as the granary of South India lying in the delta region of the famous river Cauvery. The Grains were stored in *marakutir* or *pattâyam* (wooden container) and *mankutir* at Thanjavur Delta Region. Age old storage methods are the symbols of the farmer's traditional values. Farmer's houses were built with separate spaces for

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*pattâyam* in Kurichimalai village and Kumbakonam. These *pattâyam*'s are 3 feet deep inside and 5 feet wide. It is made up of three to seven layers, depending on the size of the farmer's field. Each layer is approximately three feet high wooden boards joined together like a big rectangular or square shapes. The square boxes are stacked one above the other to form a tall Container. Depending on the capacity, 70 kg to 1750 kg of paddy can be stored. Whenever the paddy needs to be steamed, paddy is taken out through the tiny door at the bottom of the *pattâyam*. *Pattâyam* is a vault and treasury for a long time.



Different size *Pattâyam* with tiny doorway one is 7 layers and another is 3 layers in Kurichimalai village and Kumbakonam

*Mankutir* shapes like a cylinder, however it is made of mud. Mud is applied to the grooves between one cylinder and the other cylinder upon it. Once all the cylinders are set it is completely covered with dung so that

the rat does not bite. There will be an opening and closing system at the bottom of the *mankutir* to take out a little bit of paddy whenever needed.



Courtesy - <http://deepakshots.blogspot.com/2018/12/kuthir.html>

### **Storage method in Palaivananathar Temple**

Apart from the above storages, the temple has a granary made of red bricks, one such granary is located in the Palaivananathar Temple at Papanasam in Thanjavur district. This granary was built by Nayak king Ragunatha (1600 – 1634 CE). The granary near the entrance of the temple was used to store paddy harvested from in and around the village. The circular brick structure is 36 feet tall and 80 feet wide. It is conical at the top and has three openings one at the lower end, another at the centre and yet another one at the top<sup>3</sup>. The conical area will gradually shrink. Approximately 3,000 *kalam*s can be stored in the granary<sup>4</sup>.

One *kalam* is equal to 96 *Padi*. In the early time, the barn was full of paddy. Currently it looks like a sack that encloses with a drawstring<sup>5</sup>. It is believed that farmers in the region store their grains in the temple, which also accommodates contributions of the donors to the temple. It was locally called *Kommāram*<sup>6</sup> houses, the huge granaries which stand testimony to a systematic food security management not only for the temple but probably for the entire population of the temple town.



This Granary was built at the period of CE 1600 - 1634, to save grains  
<https://commons.wikimedia.org/wiki/File:GRANARY.jpg>

## Storage method in Kanchipuram District

In Kanchipuram traditional storage methods are called *maccu*, *a<sup>4</sup>ukku-p-pānais* and *nelkutir*. In most of the farmers' houses in Damal, a *maccu* or loft for the storage of paddy covers the central hall. The ceiling is fixed with a wooden plank. Thus, a space is created between the wooden plank and the ceilings to store paddy. The loft is approximately six feet in height and ten feet in length. It has a small entrance with a small door which is used for pouring the paddy inside the *maccu*. During summer, the *maccu* forms a barrier between the hot roof and the hall, which is the living area, thus cooling it during the hot days and nights.



The *maccu* doorway

In some houses, the residents keep *a<sup>4</sup>ukku-p-pānais* in a separate room. A variant of the earthen bin is the earthen pot-pile. Usually three pots are arranged one upon another, the smallest being at the top, covered over by an earthen lid fastened by a thick cloth. The pots fit exactly one over another in such a way that there is no gap left. The lips are sealed with clay

and cow dung to further ensure perfect alignment.

The residents give importance to *a<sup>4</sup>ukku-p-pânai* and *nelkutir*. The granary room, floor and walls are not painted. Rather cow dung is still used to mop the floor. The people preserve the grains and seed materials, when stored in earthen pots, preventing most storage pests. Grains and seeds are sun dried and cleaned before storing in pots. First, the farmers place a circular ring-like structure, locally called *pirimanai*, made of paddy straw on the floor. Above that ring, they place pots filled with grains one above the other. The top most pot is then closed with a lid. The grains or seed materials stored in these mud pots are kept safe and away from a wide range of storage pests for nearly six months. The porous nature of the pots permits moisture and heat to circulate easily, thus preserving the grains for a longer time. After six months, the grain is taken out and subjected to sun drying and again stored in mud pots.



Modern method of storing is called *câkkupai* and polythene bags were used for storing paddy seeds. The residents of this house give primary importance to the storage of paddy. One can observe a room fully occupied by polythene bags. Placing their paddy in *câkkupai* and polythene bags causes moisture to penetrate during the snow

and rainy season and disrupts the quality of paddy. During hot summers, the problem of heat control develops, and lines are formed, in the rice. When such paddy is milled, the granules increase and the number of rice decreases. More than all this, the ultimate problem is rat disturbance. The Rat makes a hole in the covers, tastes it, and hunts them down.

## Conclusion

Presently in most residences, this *maccu* and *pattâyam* are not used. In some houses *maccu* is used as storage place for unused things. Modern generation feels that *Pattâyam* are congested and have started to sell them. In some homes, the patrimony is preserved to preserve the heritage. Few split the deck and smashed the boards into the house like blocks. A few made it like shelves. On the whole, the *pattâyam*<sup>7</sup> was gone or deformed. A safe storage system of rice is important for ensuring food security especially for the people who are fully dependent on agriculture. Rice is generally stored by the farmers to meet their own consumption throughout the year and seed for the next sowing season.

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# THE NUTRITIONAL AND PHARMACEUTICAL ROLE OF UNDERUTILIZED CITRUS FRUIT - *Citrus maxima* Merr. – A REVIEW

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## Abstract

*Citrus maxima* Merr. fruit is the largest in size of all the varieties in citrus and popularly known as pomelo and shaddock as mentioned in ancient literature, belonging to the family Rutaceae. It is an evergreen aromatic medium size tree that occupies an important place in the medicine and also in the fruit economy of India. The plant *C. maxima* Merr. is a widely distributed indigenous plant found in the Indian subcontinent. In the traditional Indian system of medicine – Ayurveda and various folk systems of medicine, fruit, peel, pulp, juice and leaves are used to treat various inflammatory ailments. Chemical studies have shown that the fruit contains several key nutrients such as vitamin C, folate, dietary fibre, minerals and phytochemicals that contain a range of health-promoting properties. Pre-clinical studies have shown that some of its phytochemicals possess anti-microbial, anti-cancer, anti-diabetic, anti-oxidant, anti-cholinesterase, cardio and hepato-protective effects. The present paper deals with review of nutraceuticals and pharmacological action of underutilized *C. maxima* (Red and White variety) fruit.

**Keywords:** *Citrus maxima*, underutilized fruits, phytochemistry, pharmacological activity, health benefits.

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## Introduction

India is one of the most fortunate countries in the world, being endowed with a wide range of ecological conditions. The diverse agro-climatic conditions in India make it possible for the cultivation of a large number of

fruit and vegetable species. Therefore, many species of fruits and vegetables, ranging from a few tropical, many subtropical and almost all temperate zone species are grown in India. There are quite a large number of indigenous and underutilized fruit crops, which are being used by the local inhabitants

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in rural areas of our country. The underutilized fruits, their parts and their products are of excellent quality in terms of medicinal, nutritional, and economic value, but very little information is known to the researchers and local population about cultivation practices, varieties, yield and quality of underutilized fruit crops (Rathore, 2012).

*C. maxima* belongs to the family Rutaceae and is an underutilized tropical fruit. It is the largest in size of all citrus varieties and popularly known as pomelo and shaddock and it is native to Thailand and the east of India and widely spread in China, Japan, Philippines, Indonesia, and the United State of America. It is a medium sized tree. The leaves, fruits and flowers of this species are largest among all citrus varieties. Though pomelos are often confused with grape fruit, they are easily distinguished with their thicker rinds, larger size and moderate sweet flavour. It is intolerant to cold, grows upto 15 meters tall with a rounded crown. The leaves are oblong to elliptic of about 4 to 8 inches long having winged petioles. The flowers are bisexual and sweet scented. Fruits and flowers are borne singly and grow in clusters of 2 to 20. The fruit varies from round to pear shaped, green, becomes yellow or greenish yellow when ripe and measures 15-20 cm in diameter and weighs about 1-2 kg. The pulp is of two varieties; white or pinkish red, spindle shaped juice sacks that separate easily from one another and sweetish-acidic flavour (Shah, 2015). Fruit peel has 3 layers: the outer layer is called flavedo or epicarp which has oil glands, the middle layer is called albedo or

mesocarp which is white in colour and has plenty of spongy cells, and the inner juicy sac layer is called endocarp which is the edible portion of the fruit.

### **Phytochemistry**

Peel, pulp, juice, leaves, root, stem, bark, flower and seed of *C. maxima* contain several phytochemicals such as polyphenolics, flavonoids, carotenoids, coumarins and alkaloids and so on (Wang *et al.*, 2019; Abirami *et al.*, 2018). Like other citrus plants pomelos are rich in Vitamin C. They are generally eaten as fruit. It has been used in indigenous system of medicine as sedative in nervous disorder, convulsive cough and in the treatment of hemorrhagic diseases and epilepsy (Surampudi *et al.*, 2016; Simas *et al.*, 2017). Peel contains pectin (Methacanon *et al.*, 2014), coumarins (Longfei *et al.*, 2017), tri-terpenes, mono-terpenes, sesqui-terpenes, miscellaneous phyto-constituents like decanoic acid, heptyl acetate and 2-dodecenal, decan-1-al, decyl acetate, dodecyl acetate, nonal-1-al, nonyl acetate, octan-1-al and octyl acetate, (Chinapongtitiwat *et al.*, 2013). Peel of pomelo also possess many numbers of flavonoids such as naringenin, naringin, diosmetin, didymin, isorhoifolin, diosmin, luteolin, neodiosmin, neoponcirin, poncirin, rhoifolin, sinensetin, nobiletin, tangeretin, eriocitrin, naringin glucoside, hesperidin, narirutin, neoeriocitrin and neohesperidin (Abirami *et al.*, 2018; Chinapongtitiwat *et al.*, 2013; Ramful *et al.*, 2011).

Pomelo pulps possess flavonoids such as naringin, hesperidin, neohesperidin, dihydrochalcone,

naringenin and hesperidin (Makynen *et al.*, 2013). Leaves contain monoterpenes of geraniol acetate, linalool, limonene, citronellal, citral, myrcene, linalyl acetate and neral (Zhou *et al.*, 2004) and possess the flavonoids namely naringenin, naringinluteolin, poncirin, rhoifolin, narirutin, neoeriocitrin and neohesperidin, rutin and  $\alpha$ -caryophyllene sesquiterpenes (Anupama *et al.*, 2016). *C. maxima* flower contains some of the phytochemicals such as monoterpenes namely linalool, limonene, farnesol, citral, camphene and neral (Singh *et al.*, 2010; Zhou *et al.* 2004) and  $\alpha$ -caryophyllene sesquiterpenes (Taufiq-Yap and Peh, 2001). Juice contains carbohydrates such as fructose, glucose and sucrose, organic acids such as ascorbic, citric, maleic and succinic acid (Cheong *et al.*, 2012). Juice possesses flavonoids and limonoids viz., naringin, hesperidin, narirutin, neoeriocitrin, neohesperidin, didymin, sinensetin, rhoifolin, neoponcirin, neodiosmin, luteolin and diosmin, limonin and nomilin (Pichaiyongvongdee and Haruenkit, 2009). Stem bark contains acridone alkaloid namely 5-hydroxynoracronycine alcohol, glycocitrine-I, 5-hydroxynoracronycine, citrusinine-I, grandisine-I, natsucitrine-II and citracridone-III (Teng *et al.*, 2005).

### **Nutritional composition**

As per USDA, 2011, the nutrient composition of fresh pomelo per 100 g edible portion is: water - 89.10 g, energy - 38 kcal, protein - 0.76 g, total fat - 0.04 g, ash - 0.48 g, carbohydrate - 9.62 g, total dietary fibre - 1.0 g, Calcium - 4 mg, Iron - 0.11 mg,

Magnesium - 6 mg, Phosphorus - 17 mg, Potassium - 216 mg, Sodium - 1 mg, Zinc - 0.08 mg, Copper - 0.048 mg, Manganese - 0.017 mg, Vitamin C - 61 mg, Thiamin - 0.034 mg, Riboflavin - 0.027 mg, Niacin - 0.220 mg, Vitamin B-6 - 0.036 mg,  $\alpha$ -cryptoxanthin - 10  $\mu$ g and Vitamin A - 8 IU.

### **Pharmacological action**

#### **Anti-microbial activity**

Ethanollic extract of leaves showed significant antibacterial activity against *Pseudomonas aeruginosa* and *Escherichia coli* using disc diffusion method. The presence of phyto constituents such as flavonoids, alkaloids, tannins and saponins in the leaves exhibited the antibacterial activity (Das *et al.*, 2013). Ethanollic extracts of pomelo seeds and pulp was investigated for activities against *Bacillus subtilis*, *Staphylococcus aureus*, *E. coli* and *Candida albicans* (Sahlan *et al.*, 2018). Methanollic extract of different components (leaf, peel and pulp) of *C. maxima* showed moderate antibacterial activity against *Staphylococcus aureus*, *Salmonella typhi*, *E. coli*, *P. aeruginosa* and *Klebsiella pneumonia* (Abirami *et al.*, 2013). The essential oil of leaves exhibited effective antifungal activity against *Aspergillus flavus* over control from 2 to 10 days at concentration range of 250 -1000 ppm. The oils showed a broad mycotoxic spectrum against the fungi and caused 100% inhibition of the mycelia growth of *A. fumigatus*, *A. niger*, *A. terreus*, *A. alternate*, *Fusarium oxysporum*, *Helminthosporium oryzae* and *Trichoderma viride* at 750 ppm (Singh *et al.*, 2010).

## **Anti-inflammatory activity**

Ibrahim *et al.* (2018) investigated analgesic, central nervous system (CNS) depressant and anti-inflammatory activities of crude methanolic extract of peel of *Citrus maxima* fruits. The peel extract showed CNS depressant effect with moderate analgesic and anti-inflammatory properties. Acetone, ethanol and water extract of leaves, stem bark and peel were studied for acute and chronic anti-inflammatory activity using formalin induced paw edema in rats at a dose of 300 mg/Kg b.w. All the extracts showed significant ( $p < 0.001$ ) anti-inflammatory activity as compared to control (Shivananda *et al.*, 2013). KunduSen *et al.*, (2011a) tested the methanolic extracts of leaves to measure the anti-inflammatory activity by carrageenan, dextran and histamine induced paw edema in Wistar albino rats. The leaf extract exhibited a significant anti-inflammatory activity for carrageenan (43.83 and 55.39%), dextran (6.57 and 38.21%) and histamine (70.32 and 81.29%) at the dose level of 200 and 400 mg/kg b.w. respectively.

## **Anti-diabetic, Anti-hyperlipidemic and hepato-protective activity**

Ani and Ochu (2020) investigated the anti-diabetic, anti-hyperlipidemic and hepatoprotective effects of *C. maxima* peel extract on alloxan-induced diabetic rats. *C. maxima* peel extract significantly decreased ( $p < 0.05$ ) the blood glucose level by 70.17%, increase in high-density lipoprotein cholesterol (4.43%) and decrease in total cholesterol (30.86%), triglyceride (10.58%) and low-density lipoprotein

cholesterol (10.20%). Abirami *et al.* (2019) investigated the anti-diabetic and hypolipidemic activities of underutilized fruits of *C. maxima* (Red and White variety) methanolic peel and pulp extract in streptozotocin induced diabetic rats. The report showed oral administration of peel, pulp extracts and standard drug significantly ( $p < 0.001$ ) reduced blood glucose, serum cholesterol and triglycerides level. High density lipoprotein cholesterol level was found to be improved as compared to diabetic control group. Abirami *et al.* (2018) examined the *in vitro* anti-diabetic activity of methanolic extract of peel, pulp and peel fibre of *C. maxima* (Red and White varieties). Higher inhibition of 79 and 71% against  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activity was registered by peel and peel fibre extract of both the *C. maxima* varieties. Abirami *et al.* (2014) studied the *in vitro* anti-diabetic activity of *C. maxima* (Red) and *C. maxima* (White) juice extracts. The result revealed that juices of the studied citrus fruits have high potential  $\alpha$ -glucosidase inhibitory activity ranging from 70.68% to 72.83% and  $\alpha$ -amylase (75.55% to 79.75%), respectively. The anti-hyperlipidemic activities including the inhibition of pancreatic lipase and cholesterol esterase, as well as cholesterol micelle formation and bile acid binding of methanolic extract of pulp from 6 different cultivars of pomelo namely Kao-Yai (KY), Thong-dee (TD), Kao-Tangkwa (KT), Kao-Numpueng (KN), Ta-Koi (TK) and Tubtim Siam (TS) were investigated (Makynen *et al.*, 2013). All the extracts markedly inhibited pancreatic lipase activity in a dose-dependent manner ranging from 1.50-2.90 mg/mL with IC<sub>50</sub> values ranging

from 0.25-0.34 mg/ml. Six pomelo cultivars showed to inhibit the formation of cholesterol micellization ranging from 8.34-14.70%. The primary bile acid (taurocholic acid) was highly bound with TD, KN and TK samples than the others, whereas secondary bile acid (taurodeoxycholic acid) were markedly bound by all the pomelo cultivars ranging from 14.65-20.50% and 5.60-16.93% for glycodeoxycholic acid. Abirami *et al.* (2015) reported the hepatoprotective effects of *C. maxima* (Red and White variety) methanolic leaf extracts on paracetamol induced toxicity. This study has proved that the mechanism of hepatoprotection by methanolic extracts of *C. maxima* (Red and White) leaves is due to their antioxidant potential. This suggests that leaf extracts can reduce reactive oxygen species (ROS) that may lessen the oxidative damage to the hepatocytes and improve the activities of the liver antioxidant enzymes, thus protecting the liver from paracetamol induced damage.

### **Anti-tumour, analgesic and anti-depressant activity**

Methanolic extract of pomelo leaves were evaluated for anti-tumor activity against Ehrlich's ascites carcinoma tumour model. The activity was assessed using tumour volume, viable tumour cell count and increased body weight, haematological studies and survival time. Leaf extract was found to be significant anti-tumour activity at doses of 200 and 400 mg/kg b.w. (KunduSen *et al.*, 2011b). Analgesic activity of acetone, ethanol and water extract of leaves, stem bark and peel of pomelo was evaluated by using acetic

acid induced writhing, hot plate methods in mice and tail flick methods in rats at dose of 300 mg/Kg b.w. All the extracts showed a significant analgesic activity as compared to control (Shivananda *et al.*, 2013). Anti-depressant activity of aqueous extract of leaves were investigated by using modified forced swimming test, tail suspension test in mice at a dose of 100, 200 and 300 mg/kg b.w. Leaf extract in all the doses were able to reduce immobility and to increase climbing time. Leaf extract at the dose of 300 mg/kg exhibit similar activity to the effect of positive control imipramine (Potdar and Kibile, 2011).

### **Anti-oxidant activity**

Ariful *et al.* (2021) studied the antioxidant capacity of methanolic and ethanolic extracts of *C. maxima* leaf. Both extracts showed notable free radical scavenging activity in total antioxidant capacity assay, ferric reducing antioxidant power assay, 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) Assay, free radical scavenging assay, and 2,2'-azino-bis (3-ethyl benzothiazoline-6-sulfonic acid) (ABTS) free radical scavenging assay. Lee *et al.* (2020) investigated the effects of ethanol concentration on the extraction of polyphenol and flavonoid from *C. maxima* (Dangyuja) and investigated the antioxidant and anti-inflammatory activity of the extracts by *in vitro* methods. Anti-oxidative activities were confirmed using the total polyphenol and flavonoid contents, and ABTS radical scavenging effect. Methanolic extract of peel, pulp and peel fibre from underutilized fruits of *C. maxima* (Red and White variety) were



examined for phenolic content and anti-oxidant activity systems. Both varieties of *C. maxima* peel fibre (66 – 77 mg gallic acid equivalents/gram extract) possess higher Total Phenolic Content which exhibits the higher anti-oxidant activity (Abirami *et al.*, 2018). The anti-oxidant and anti-radical activities of pomelo fruits are mainly due to the presence of carotenoids, lycopene, polyphenols, flavonoids, limonoids, pectin, fibre and Vitamin C, leading to their protective effects against chronic diseases. Makynen *et al.* (2013) investigated to determine the anti-oxidant activity of methanolic extract of pulp from 6 different cultivars of pomelo namely Kao-Yai (KY), Thong-dee (TD), Kao-Tangkwa (KT), Kao-Numpueng (KN), Ta-Koi (TK) and Tubtim Siam (TS). Scavenging ability assays of the extracts for radicals like DPPH, ABTS, Ferric Reducing Anti-oxidant Power Assay (FRAP), hydroxyl and superoxide were performed. Among the samples KY and KN were found have shown highest antioxidant and polyphenols content. Flavonoids such as naringin, hesperidin, neohesperidin and naringenin in these pomelo extracts have shown anti-oxidant activity that is directly related to their ability to inhibit the free radical formation.

## Conclusion

Citrus fruits have served human as symbols of religious devotion, additions to beautiful landscapes and important food to preserve health. On reviewing all these literature, it is found that underutilized fruits are important for food security, nutrition, agriculture development and rotation of crops to improve the nation's economy. The

underutilized fruit of *C. maxima* is playing a major role in biodiversity and sustainable use for future generations. The underutilized fruits of *C. maxima* (Red and White) might be valuable in free radical mediated degenerative diseases, inflammation, diabetes and hepatoprotective treatment and the cheap renewable bioresources of peel and peel fibre could serve as a suitable by-product to be used in the preparation of a low calorie with rich nutritive diet. However, further studies on lead molecules of both the interventions, their mechanism of action responsible, pharmacokinetics and other therapeutic contributions of these interventions will be necessary. In addition, the proper conservation, cultivation and utilization of these underutilized fruits will appear to be the promising fruits for future and also strengthening the agro biodiversity in the rural vicinity.

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# ETHNOBOTANICAL STUDIES IN SELECT PARKS OF CHENNAI CITY

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## Abstract

*A survey was carried out to collect information of ethno botanical use of the medicinal plants in select parks of Chennai city, Tamil Nadu. A total of 60 plant species from 54 genera belonging to 37 families were enumerated to treat various diseases. The plants include herbs (25 species, 42%), trees (20 species, 33%), climbers (9 species, 15%) and shrubs (6 species, 10%). The dominant families are Euphorbiaceae, Lamiaceae, Solanaceae, Amaranthaceae, Caesalpiniaceae, Malvaceae, Acanthaceae, Apiaceae, Basellaceae, Asclepiadaceae, Asteraceae, Combretaceae, Meliaceae, Moraceae, Umbelliferaceae, etc. The documented medicinal plants were used mostly to cure diseases like urinary disorders, skin diseases, ear problems, fever, cough, cold, menstrual problem, inflammation, malaria, liver problem, piles, eczema, diabetes, asthma and poison bites etc. This paper illustrates that the people even in Metro cities still continue to depend on medicinal plants for first aid and treatment of primary ailments.*

**Keywords:** Medicinal plants, parks, diseases, treatment.

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## Introduction

Over three-quarters of the world population relies mainly on plants and plant extracts for health care. The Indian subcontinent is a vast repository of medicinal plants that are used in traditional medical treatments, around 20,000 medicinal plants have been

recorded (Dev, 1997), but only 7,000 - 7,500 plants are being used by traditional communities for curing different diseases (Perumal and Ignacimuthu, 1998, Kamboj 2000). The medicinal plants are listed in various indigenous medicinal systems such as *Siddha* (600 species), *Ayurveda* (700 species), *Amchi* (600 species) and *Unani*

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(700 species) (Rabe and Staden, 1997). Major pharmaceutical industries depend on the plant products for the preparation of medicines (Anbarashan and Padmavathy, 2010).

In Tamil Nadu, the local rural people have an indigenous knowledge on developing the groves for their culture and recreation and these groves are rich in biodiversity. About 60% of the plants present in groves are having medicinal values, of which nearly 28% serves as folk medicines.

Cities like Chennai does not have major groves instead there are several urban parks. The urban parks apart from providing green and open space for recreational purposes also provide a number of ecosystem services. Ecosystem services are defined as “the benefits human populations derive, directly or indirectly, from ecosystem functions” (Costanza *et al.* 1997). According to Bolund and

Hunhammar (1999), trees in urban areas offer a variety of ecosystem services like air and water purification, rain water recharge, noise filtering, health, microclimate stabilization and biodiversity conservation. This study provides information on the ethnobotanical importance of the plants in the select parks of Chennai city.

### Methodology

Total geographical area of Chennai is 184 Sq. Kms, constituting just 0.13% of the area of the State. Chennai is situated on the north-east end of Tamil Nadu on the coast of the Bay of Bengal. It lies between 12° 9' and 13° 9' of the northern latitude and 80° 12' and 80° 19' of the southern longitude on a ‘sandy shelving breaker swept beach’. It stretches nearly 25.60 kms, along the Bay coast from Thiruvanmiyur in the south to Thiruvottriyur in the north and runs inland in a rugged

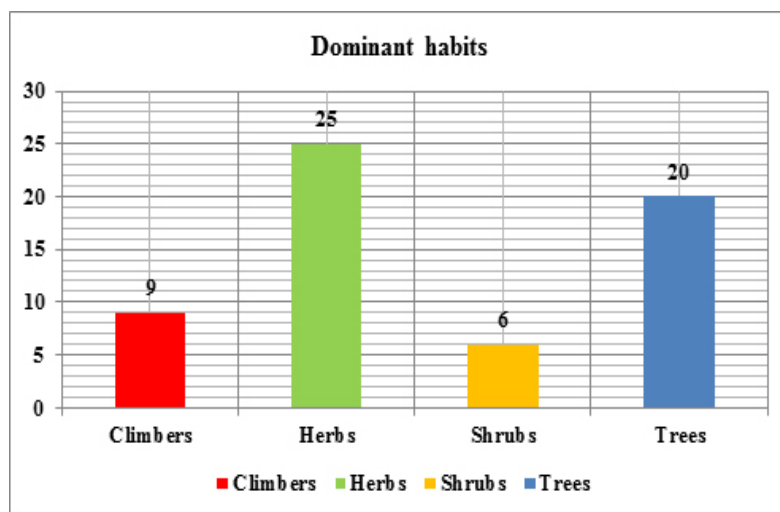


Fig. 1: Medicinal usage of dominant life form in Select Chennai Parks

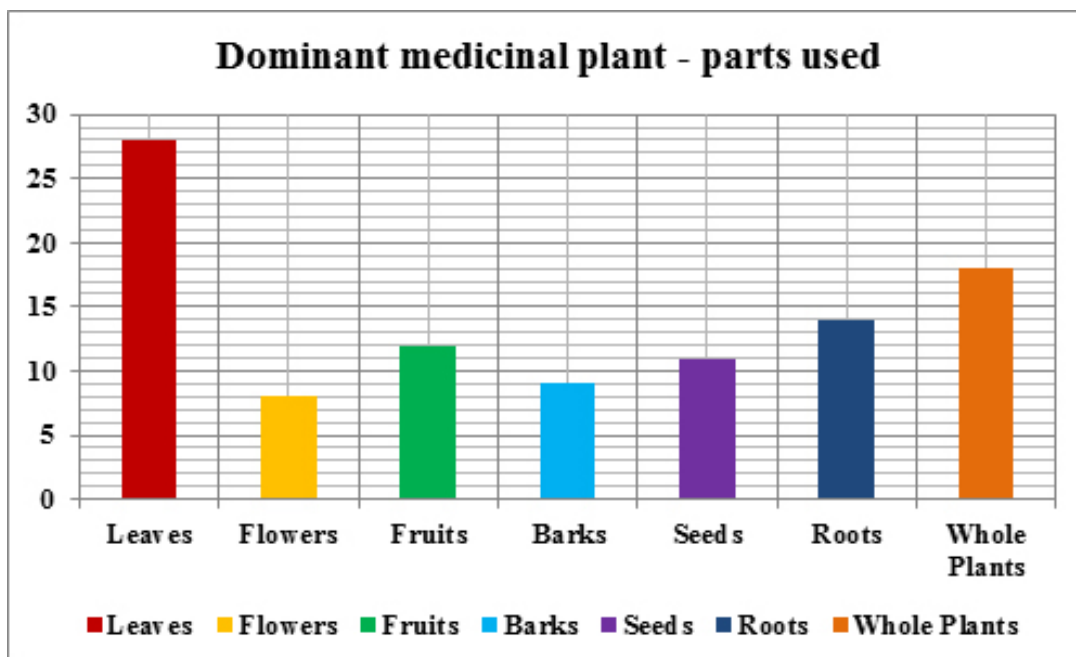


Fig. 2: Dominant medicinal plant usage parts

semi-circular fashion. It is bounded on the east by the Bay of Bengal and on the remaining three sides by Kanchipuram and Thiruvallur districts.

### Data collection

Survey was carried out during the year 2015 and 2016 in the major parks which are well maintained and to mention a few are the Napier Park, my Lady's Park, Nageswara Rao Park, Independence Park, Anna Park, Natesan and Panagal Park. Plants were collected and identified by using the

standard literature such as *Flora of Madras Presidency* by Gamble, 1915-1936. *Further Illustrations on the Flora of the Tamil Nadu and Carnatic* by Matthew, 1982-1988, have also been referred for the correct botanical names for the specimens identified. The indigenous medical practitioners and the local medicine man (*Maruthuvar*) were interviewed, and the medicinal plants of Chennai parks were documented. The details of the plants including their vernacular name, useful parts of the plants and medicinal uses are given in Table 1.

**Table 1: Medicinal plants used by traditional healers from Chennai district of Tamil Nadu**

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
1	<i>Abutilon indicum</i> (L.) Sweet	H	Malvaceae	Thuthi	Indian mallow	Whole plant	The leaf decoction is used as mouth wash for toothache and tender gums. Decoction of the root is used in the treatment of diabetes. The leaves are roasted in castor oil and applied to cure piles, itching of anus, fistula.	Diabetes, tooth ache, Piles, and itching of anus.
2	<i>Acalypha indica</i> L.	H	Euphorbiaceae	Kuppaimeni	Indian Acalypha	Whole plant	The plant is used to cure chronic bronchitis, asthma. The leaf decoction is used as laxative. The leaves are made into a paste and applied for syphilitic ulcers, bed-sores and wounds. The leaf extract is mixed with lime juice and used as an antitode for scorpion sting and rat bites	Bronchitis, asthma, Laxative, scorpion sting and rat bites



S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
3	<i>Achyranthes aspera</i> L.	H	Amaranthaceae	Nayuruvi	Pricklychaff-flower plant	Whole plant	The leaf paste, pepper and garlic is dried and taken to cure fever. Leaf paste mixed with turmeric is applied to cure piles. It cures constipation when leaf is taken with water. The decoction cures stomach pain, indigestion, acidity.	Fever, stomach pain, indigestion and piles
4	<i>Aegle marmelos</i> (L.) Correa	T	Rutaceae	Vilvam	Bengal Quince	Leaf, fruit and root	The leaf is heated over low flame and gently massaged over the eyes to cure eye pain, redness in eyes. The root soaked in water ginger and fennel seeds consumed to cure piles. Decoction prepared with fruit pulp and sugar gives strength to the body.	Eye problems, energy drink piles.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
5	<i>Aerva lanata</i> (L.) Juss.	H	Amaranthaceae	Sirukannpeelai	Aerva	Whole plant	Leaf juice cures urinary infections and controls excessive bleeding during menstruation. Gruel made with this root gives strength to pregnant woman.	Urinary infection, menstrual disorder
6	<i>Aloe vera</i> (L.) Burm.f.	H	Liliaceae	Sotrukatalai	Indian Aloe	Whole plant	The gel of the plant mixed with gingelly oil in equal proportion and boiled and applied as hair tonic for hair growth and to stop hair fall. The strained juice and rose water is mixed and used for cleaning the eyes. Leaves are dried, powdered and consumed regularly to keep young and fit	Hair fall, eye problems, body fit

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
7	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	H	Amaranthaceae	Ponnanganni	Sessile Joy weed	Leaf	The green has the properties of gold and when consumed with salt, pepper and tamarind, it gives long and healthy life. When cooked and consumed without salt for 40 days, it cures several eye problems. Mouth ulcers, mouth odour are cured.	Eye problems and mouth ulcer
8	<i>Andrographis paniculata</i> (Burm.f.) Nees	H	Acanthaceae	Nilavembu	The Creat	Whole plant	The decoction of the dried sticks and leaf is given to children to cure stomach pain and fever. The leaf juice is given to cure bowel complaints of children. It cures rheumatic fever, flatulence and liver disorders.	Stomach pain, fever and liver disorder

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
9	<i>Annona squamosa</i> L.	T	Annonaceae	Seetha	Custard apple	Leaf and fruit	The fruits and leaves are made into a paste without adding water and is applied to cure skin ulcers and eczema. Leaf juice is used as nasal drops to cure unconsciousness.	Ulcer, eczema and Unconsciousness
10	<i>Anthocephalus cadamba</i> (Roxb.) Miq.	T	Rubiaceae	Kadambu	Wild chincona	Fruit, leaf and bark	A decoction is made out of the bark and is given to cure fever. The juice of the fruit mixed with cumin cures gastric problems among children. The root is slightly bitter and acts as a coolant and laxative.	Fever, gastric problems, coolant and laxative
11	<i>Argemone mexicana</i> L.	H	Papavaraceae	Bramhadhandi	Mexican Poppy	Whole Plant	The oil obtained from the seed is purgative. A decoction made from the root is used to wash eyes and used	Inflammation, jaundice, skin disease

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
12	<i>Azadirachta indica</i> A.Juss.	T	Meliaceae	Vembu	Neem	Leaf, bark and seed	<p>as a lotion for inflammatory swellings. The juice of the plant is diuretic and is given to cure jaundice and skin diseases The oil is locally applied over skin diseases.</p> <p>Fresh juice is mixed with salt and given for intestinal worms. A decoction of the fresh leaves is consumed for malarial fever. Leaves are made into a paste and applied over skin diseases. The tender twigs are used as tooth brush to keep the teeth and gums healthy. Fruit is used for urinary disorders.</p>	Intestinal worm, malaria, skin diseases and urinary disorders.
13	<i>Basella alba</i> L.	C	Basellaceae	Pasalai	Malabar Spinach	Leaf	<p>Fresh leaves are more nutritious than cooked leaves. The water become viscose when the leaves are soaked</p>	Induce sleep, cures phlegm, cold and urinary infection

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
14	<i>Cardiospermum halicacabum</i> L.	C	Sapindaceae	Mudakkatran	Balloon vine	Leaf and root	<p>which is applied on the forehead to induce sleep. The leaf juice is mixed with sugar candy and given to cure phlegm and cold. It is a good laxative and cures urinary infections.</p> <p>2 drops of leaf juice is administered in the ear to cure ear ache. Water soaked with leaf and root may be taken thrice to cure prolonged cough. The dried root soaked in water may be taken in to cure piles. Knee pain is cured when the leaf is boiled in oil and applied.</p>	Ear ache, cough, piles and knee pain
15	<i>Carica papaya</i> L.	T	Caricaceae	Pappali	Papaya	Fruit	Fruit and milk extract kills worms in the	Appetizer, piles, constipation,

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
16	<i>Carissa spinarum</i> L.	S	Apocynaceae	Sirukala	Carissa	Fruit and root	intestine and a good appetizer. The fruit cures urinary infection and strengthens the body. Fruit cures prolonged piles and constipation. Fruit cures diabetes when consumed with jamun fruit. It is good for eyesight.  The root is useful in treating uterus problems after delivery. The fruit is an appetizer and reduces body pain. The fruit is eaten to reduce ear block. The unripe fruits are used as pickles.	diabetes and eye problems  Uterus problem, body pain and reduce ear block
17	<i>Cassia auriculata</i> L.	S	Caesalpiniaceae	Avaram	Tanner's cassia	Flower, leaf and seed	Flowers are dried under shade and made into a powder, the powder is mixed in boiled water and consumed to control diabetes. Flowers, seeds and leaves are used to cure skin diseases.	Diabetes, Skin diseases

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
18	<i>Cassia tora</i> L.	H	Caesalpinaceae	Thagarai	Foetid Cassia	Leaf, seed and	The decoction of disorders, root leaves is given to children having intestinal disorders. Ringworms can be cured by applying a paste of the root made with lime juice. The seed is powdered and mixed with butter and used for skin ulcers.	Intestinal ring worm and ulcers.
19	<i>Centella asiatica</i> (L.) Urb.	H	Apiaceae	Vallaarai	Indian Pennywort	Leaf	It cures mouth ulcers. When it is consumed regularly it increases resistance power in body and prevents any diseases. It can cure certain skin diseases including leprosy.	Mouth ulcer
20	<i>Cissus quadrangularis</i> L.	C	Vitaceae	Pirandai	Edible-stemmed vine	Root	It is a good appetizer. Cures indigestion when powdered and consumed with pepper and ginger. Dried root	Appetizer, Indigestion, sprain, wound and inflammation



S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
21	<i>Clitoria ternatea</i> L.	C	Fabaceae	Sangu Pushpam	Butterfly Pea	Leaf and root	powder is consumed to fasten bones in case of accidents. In case of sprains, wounds and inflammation, the juice with tamarind and salt is heartened and applied for fast relief  The leaf juice is mixed with ginger and given to check fever. The roots are used in treating indigestion, constipation and irritation of the bladder and urethra. The leaf juice is given with cold milk for chronic bronchitis.	Fever, indigestion and bronchitis
22	<i>Coleus amboinicus</i> Lour.	H	Lamiaceae	Karpooravalli	Indian Borage	Leaf	The juice extracted from the leaves are mixed with sugar candy and given to children to cure prolonged cough. For head ache fresh leaves are squeezed and applied	Cough, head ache and inflammation of lungs

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
23	<i>Coriandrum sativum</i> L.	H	Umbelliferaceae	Kothamalli	Coriander	Whole plant	<p>on the fore head. The leaf juice can cure inflammation of lungs.</p> <p>The leaf paste is mixed with milk and sugar is given for treating bleeding piles. The paste of the seed is applied for chronic ulcers of the throat. The seeds can be chewed to get rid of tooth ache and gum inflammation.</p>	Bleeding piles, throat pain and tooth ache.
24	<i>Cynodon dactylon</i> (L.) Pers.	H	Poaceae	Arugampul	Bermuda grass	Whole plant	<p>The juice obtained from the plant is used to stop bleeding of cuts and wounds. The grass mixed with milk is prescribed for bleeding piles, irritation of the urinary organs and vomiting. The juice of the plant is given in chronic diarrhea and dysentery.</p>	Stop bleeding, vomiting, diarrhea, dysentery.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
25	<i>Delonix elata</i> (L.) Gamble	T	Caesalpiaceae	Vadhanarayanan	White Gulmohur	Leaf	It clears constipation when leaf juice and castor oil is boiled and consumed and clears gastric trouble. Body rashes and eczema are cured when paste of the plant's leaf, kuppaimeni and turmeric is applied and washed later.	Gastric trouble and eczema
26	<i>Eclipta alba</i> (L.) Hassk.	H	Asteraceae	Karisalai	Trailing Eclipta	Whole plant	The fresh plant is used as a liver tonic. 2 drops of the leaf juice is mixed with few drops of honey and given to cure cough and watering of nose among children. The fresh juice of the leaves is applied over the shaven scalp for good hair growth.	Running nose and hair growth.
27	<i>Eclipta prostrata</i> (L.) L.	H	Asteraceae	Manjalkarisalai	False daisy	Whole plant	2 to 3 drops of the leaf juice is administered in the ear to cure ear problems. The leaf	Ear problems, hair tonic, ulcer, spleen and liver disorder.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
28	<i>Emblica officinalis</i> Gaertn.	T	Euphorbiaceae	Peru Nelli	Indian Gooseberry	Leaf, bark, fruit and flower	juice mixed with gingelly oil and heated and applied as hair tonic. The root powder is used to cure ulcers, spleen and liver disorders. It cures vomiting, indigestion, acidity. The juice is consumed with honey to cure chronic bronchitis. The leaf and root are given to cure jaundice. The fruit is applied on hair to prevent early graying and hair fall.	Vomiting, indigestion, bronchitis, jaundice and hair fall.
29	<i>Euphorbia hirta</i> L.	H	Euphorbiaceae	Ammaan Pacharisi	Asthma weed	Whole plant	The milky latex is applied directly to cure pimples and acne. This plant is used as a supplement medicine for cough, asthma and mouth ulcers.	Acne, cough, asthma and mouth ulcer.
30	<i>Ficus glomerata</i> Roxb.	T	Moraceae	Athi	Indian fig	Fruit	The unripe fruits are cooked and consumed to cure stomach ache,	Stomach ache, piles, Increase hemoglobin in blood.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
31	<i>Ficus religiosa</i> L.	T	Moraceae	Arasam	Peepal	Leaf, bark and seed	the fruit used in the treatment of piles. The dried fruits improves the hemoglobin content in the blood.  Leaves are used to cure ear aches, wounds, burns, nausea and inflammation. The juice of the bark relieves toothache and strengthens the gum. The powder made from the fig is given for asthma.	Ear aches, wounds, tooth ache and asthma
32	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	C	Asclepiadaceae	Sirukurinjan	Gymnema	Leaf and root	Dried leaves are mixed with equal quantity of jamun seeds and powdered and is taken for 40days with warm water to cure diabetes. It is an appetizer and coolant. The roots are used as antitode for poisonous bites.	Diabetes, appetizer, coolant and antitode.
33	<i>Heliotropium indicum</i> L.	H	Boraginaceae	Thelkodukki	Indian Turnsole	Leaf and flower	The leaf is made into a paste with turmeric and applied over boils	

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
34	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	C	Asclepiadaceae	Nannaari	Indian Sarasaparila	Root	<p>and bruises. The leaf juice is an antitode for scorpion sting. The infusion of the leaves and flowers is used as a mouth wash to relieve throat pain and throat ulcers. The juice of the leaves cures pimples.</p> <p>Dried and powdered roots are consumed with milk to cure urinary infections. Powdered roots are mixed with aloe vera and consumed to prevent after effects of poisonous bites. The root immersed in 100 ml. water is consumed thrice to cure indigestion.</p>	<p>Bruises, antitode for scorpion king, throat pain, reduce pimples.</p> <p>Urinary infection and indigestion</p>
35	<i>Hibiscus rosa-sinensis</i> L.	S	Malvaceae	Chembaruthi	Shoe flower	Leaf and flower	<p>The leaf paste is applied over the head and taken bath to cure dandruff. The flowers are roasted in ghee and given to control</p>	<p>Dandruff, Urinary disorder and Menstruation problems.</p>

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
36	<i>Justicia adhatoda</i> L.	S	Acanthaceae	Adathoda	Adathoda	Leaf and root	excessive bleeding during menstruation. The flower is soaked in water and consumed to cure urinary tract diseases.  Juice taken from the leaves is mixed with honey or with ginger juice and consumed to cure chronic bronchitis, equal amount of leaf extract and root can cure asthma.	Chronic bronchitis, Asthma.
37	<i>Lawsonia inermis</i> L.	T	Lythraceae	Marudhani	Henna	Leaf, bark, fruit, seed and root	It is an antiseptic and cures fungal infections in fingers when the paste is applied. The paste may be applied to cure prolonged rashes and skin diseases. The leaf is made into a paste and bandaged over the feet to protect the eyes during measles.	Fungal infection, skin diseases, eye problems.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
38	<i>Leucas aspera</i> (Willd.) Link	H	Lamiaceae	Thumbai	White Dead nettle	Leaf and flower	1 to 2 drops of leaf juice is administered in nostrils to clear phlegm. Leaf paste is applied and washed after some time to cure rashes and other skin diseases. Leaf juice cures common cold and cough. 2 to 3 drops are administered in nostrils to cures severe headache.	Phlegm, rashes, skin diseases, cold, cough and head ache.
39	<i>Melia azadirachta</i> L.	T	Meliaceae	Malaivembu	Persian lialac	Leaf, flower, seed and root	It is used to cure piles and also to expel worms. The leaf poultice is used for nervous disorders. The leaves and bark are used to cure leprosy.	Nervous disorders and Leprosy
40	<i>Mimosa pudica</i> L.	H	Mimosaceae	Thottarsurungi	Sensitive plant	Leaf and root	The juice of the leaves and roots are applied externally to cure piles, fistula, boils and bruises. Leaves are made into a fine paste and applied to cure	Piles, bruises, inflammation, knee pain and hip pain.



S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
41	<i>Momordica charantia</i> L.	C	Cucurbitaceae	Paagal	Bitter Gourd	leaf, fruit and seed	inflammation of the testicles, joints and knee pain. Hot decoction of the leaves is applied on the hips to relieve pain.  It is a good appetizer and controls constipation. The Leaf juice kills the worms in the stomach. Fruit juice with sugar is consumed by women to cure stomach pain during periods. It is a good medicine for diabetes. It also cures rheumatic pains.	Stomach problems, diabetes and rheumatic pains.
42	<i>Moringa oleifera</i> Lam.	T	Moringaceae	Murungai	Drumstick	Leaf	Leaf juice mixed with lemon juice clears pimples. Leaf paste is applied to reduce inflammation. Leaf juice with pepper is applied on the forehead to cure headache. Oil from the seed helps in reducing rheumatic	Inflammation, head ache and eczema.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
43	<i>Nyctanthes arbor-tristis</i> L.	T	Oleaceae	Pavazhamalli	Coral jasmine	Leaf, flower and bark	<p>pain. Rashes and eczema is cured when leaf extraction along with extraction of kuppaimeni leaf and coconut oil.</p> <p>The tender leaves are mixed with ginger juice and given for periodic fever. The leaves are soaked in hot water and consumed twice daily to cure back pain. The leaf juice is mixed with salt and honey to children to de-worm. The bark is eaten with betel.</p>	Fever, back pain, de-worm
44	<i>Ocimum basilicum</i> L.	H	Lamiaceae	Thiruneetru pachilai	Common Basil	Whole plant	<p>2 to 3 drops of leaf juice is administered in the ear to cure ear ache. The juice obtained from the leaves is used to cure ringworms and other skin diseases.</p>	Ear ache, ring worm, skin diseases.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
45	<i>Ocimum tenuiflorum</i> L.	H	Lamiaceae	Thulasi	Sacred Basil	Whole plant	<p>Mixture of sweet flag (Vasambu) powder and the leaf juice is applied to cure pimples.</p> <p>The decoction is given to cure malaria, gastric diseases of children and liver disorders. The leaf juice is used for ringworms and other skin diseases. To prevent lice and dandruff, leaf juice mixed with lemon juice may be applied on the hair and washed after 1 hr.</p>	Malaria, liver disorder, ring worm, skin diseases and dandruff.
46	<i>Phyllanthus niruri</i> L.	H	Euphorbiaceae	Keelanelli	Stonebreaker	Whole plant	<p>The root is ground into a paste and mixed with milk and consumed to cure jaundice. The leaves are chewed to check hiccup. A poultice of leaves mixed with salt is used in the treatment of itch and scaly skin diseases.</p>	Jaundice and skin disease.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
47	<i>Pongamia pinnata</i> (L.) Pierre	T	Papilionaceae	Pungam	Indian beech	Leaf, flower, seed and root	It is an antiseptic and strengthens the body. The milk extract from the plant is applied on wounds for fast relief. Seed powder mixed with honey is given to Children with whooping cough. The oil from the seed is applied to cure eczema, ring worms and rashes.	Antiseptic, pain relief, cough, eczema, ring worm and rashes
48	<i>Punica granatum</i> L.	T	Punicaceae	Madhulai	Pomegranate	Whole plant	The flower and unripened fruit may be dried and powdered and taken to cure cough. Children may be given powder of dried flowers to cure dysentery. Fruit provides cure from piles at an early stage. The fruit juice along with sugar granules reduces body heat. Root barks and clove extraction kills ring worm in the intestine.	Cough, dysentery, reduce body heat and worm.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
49	<i>Ricinus communis</i> L.	S	Euphorbiaceae	Amanakku	Castor oil plant	Leaf and seed	The leaves of the plant is warmed over fire and applied to the breasts of nursing mothers as a lactagogue. Leaves are applied on the abdomen to promote menstrual flow. The oil obtained from the seed is laxative.	promote menstrual flow, laxative.
50	<i>Solanum indicum</i> L.	S	Solanaceae	Sundakkai	Devil's Fig	Fruit and root	The fruits are cooked and eaten. The dried fruit is roasted in ghee and powdered and mixed with rice and eaten to kill worms in the stomach. The root bark is made into a powder and inhaled for head ache and cold.	Headache and cold.
51	<i>Solanum nigrum</i> L.	H	Solanaceae	Manathakkali	Black Nightshade	Leaf and fruit	The leaf juice may be consumed thrice daily to cure body heat, mouth ulcers. When cooked with dhal cures constipation and phlegm. The fruits are	Body heat, mouth ulcer, urinary infection, stomach ulcers and worm.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
52	<i>Solanum trilobatum</i> L.	C	Solanaceae	Thoodhuvalai	Purple-fruited pea eggplant	Whole plant	soaked in buttermilk and dried and consumed. It cures several urinary infections, stomach ulcers, kills worms.  The leaf decoction is given to children to cure fever with phlegm. 1 to 2 drops of leaf juice is administered in the ear to cure ear ache.	Fever and ear ache.
53	<i>Solanum xanthocarpum</i> Schrad. & H. Wendl.	H	Solanaceae	Kandankathiri	Indian solanum	Whole plant	The leaves are powdered and mixed with coconut oil, boiled, filtered and applied over the body to get rid of body odour. The decoction of the root is given for coughs, asthma and fever.	Coughs, asthma and fever.
54	<i>Syzygium cumini</i> (L.) Skeels	T	Myrtaceae	Naaval	Black Plum	Bark and seed	Good appetizer and reduces diabetes when the seed is powdered and consumed	Appetizer, stop bleeding, relief pain.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
55	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	T	Combretaceae	Marudhamaram	Arjun	Leaf, fruit, bark and seed	every day. Bark is powdered and mixed with butter milk and consumed to stop over bleeding. The bark paste is applied on wounds and inflamed parts for relief.  The bark provides strength to heart. The leaf paste mixed with milk and consumed twice for 3 days to cure cracks in the feet. Bark paste is added to milk and consumed to cure bone fracture.	Cracks in the feet and bone fracture.
56	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	T	Combretaceae	Thandri	Beleric Myrobalan	Fruit	The fruit is bitter and purgative. The pulp of the fruit is mixed with salt, long pepper and honey is used to cure cough, sore throat. The kernel is made into a paste and applied over the wounds. The oil extracted from the kernel is used as a hair tonic.	Cough, throat pain, wound and hair tonic.

S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
57	<i>Thespesia populnea</i> (L.) Sol. ex Correa	T	Malvaceae	Poovarasu	Portia Tree	Leaf, flower, bark, seed and root	It kills the worms in our body. The extracted oil is applied on venomous bites for relief. Dried bark of 100 year old tree is powdered and consumed to cure leprosy. The bark is washed and the extracted oil is mixed with coconut oil and applied to cure all types of skin problems.	Venomous bite, leprosy and skin diseases.
58	<i>Tinospora cordifolia</i> (Willd.) Miers	C	Menispermaceae	Seendhilkodi	Heart-leaved Moonseed	Whole plant	The fresh plant is more effective than dried ones. To cure wounds castor oil is applied over the leaves and heated over fire and used as bandage. The leaf paste is consumed in empty stomach for 60 days to control diabetes. The fresh juice is mixed with milk and used as general tonic.	Wound and diabetes.



S. No.	Botanical name	Habit	Family	Vernacular name	Common name	Plant part uses	Administration and mode of preparation of medicines	Medicinal use (diseases)
59	<i>Tribulus terrestris</i> L.	H	Zygophyllaceae	Nerunjil	Land calthrops	Whole plant	Controls body heat and provides strength. It also cures urinary infections. The seeds are given daily in impotence, and incontinence of urine. It is a good medicine for scorpion bite.	Control body heat, urinary infection and scorpion bite.
60	<i>Vitex negundo</i> L.	T	Verbenaceae	Nochi	Indian Privet	Leaf, flower, bark and root	It removes phlegm and worms in the stomach and strengthens the body. It is given to children with stomach problems. It cures rheumatic pains when juice is consumed with pepper and ghee. Paste of leaf with ginger is applied on forehead to cure headaches. Fever and phlegm is cured when the leaf is added to hot water and vapour is inhaled.	Stomach problems, rheumatic pains, forehead and fever.

H - Herb    T - Tree    C - Climber    S - Shrub

## Result and discussion

The results of the survey are presented in Table 1 and the families of the plants are arranged in alphabetical order. The present investigation comprises 60 species of ethno medicinal plants distributed among 54 genera belonging to 37 families. For each species botanical name, family name, local name, parts used, methods of preparation and administration for treatment are provided. Herbs (25 species, 42%) were found to be the most used plants (Fig.1) followed by trees (20 species, 33%), climbers (9 species, 15%) and shrubs (6 species, 10%). The dominant families include Euphorbiaceae, Lamiaceae, Solanaceae, Amaranthaceae, Caesalpiniaceae, Malvaceae, Acanthaceae, Asclepiadaceae, Asteraceae, Combretaceae, Meliaceae, Moraceae, Apiaceae, Basellaceae and Umbelliferaceae.

The mostly used plant part for medicinal purpose is leaves (28%) followed by whole plant (18%), roots (14%), fruits (12%), seeds (11%), barks (9%) and flowers (8%) (Fig. 2). According to Karthik et al. (2016) leaves are the major plant part used as medicine for various diseases.

Apart from the aesthetic value of the parks, medicinal value can be ascribed as an important value. Nearly 45% of the plants, both cultivated and weeds are reported to be of medicinal value. Plants such as *Acalypha indica* and *Phyllanthus niruri* are harvested by the local people from the parks for medicinal uses. *Pongamia pinnata* is used by the gardeners and other workers of the parks as an antiseptic and blood coagulant for cuts and wounds. A number of edible greens such as, *Cardiospermum halicacabum*, *Moringa oleifera*, *Solanum indicum*, and *S. nigrum*. Some of the greens collected are used as medicinal greens. *Cardiospermum halicacabum* is used for treating joint pains. Similarly, leaves of *S. nigrum* are cooked and eaten to cure mouth ulcers. The juice of *Cynodon dactylon* has become a popular health product in Chennai which is sold fresh. Leaves of *Lawsonia inermis* are harvested for cosmetic purposes. Fallen flowers of *Hibiscus rosa-sinensis* are collected from the parks for cosmetic purposes as well as for health drink. In fact parks are the major habitats for these plants, as most of the open spaces and other habitats have been largely urbanized.

## Conclusion

The present study was explored for the medicinal value of important plants which is found in the parks of Chennai which are used for simple and complicated diseases. Such parks were destroyed by the Vardha cyclone. Many trees were uprooted and because of that the under storey plants were also affected. However, it is an urgent need to restore the parks by planting native trees which already existed in the respective parks. If this is carried out in war footing, the parks would be getting their previous status and can be more useful for the people and also maintain the local floral and ethnobotanical values.

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