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# Assessment of Plant Diversity of Chavakkad Beach, Thrissur District, Kerala, India

**Sareena Parattuveettil Mohamed, Parappully Tessy Paul* and Joshy Kakkassery Simon**

*Department of Botany, Christ College (Autonomous), (Affiliated to University of Calicut), Irinjalakuda, Thrissur - 680125, Kerala, India*

**Corresponding author*

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**A B S T R A C T**

Surveys were undertaken to explore the coastal plant diversity in Chavakkad Beach during 2018-19. The present investigation identified 131 species of plants belonging to 106 genera under 40 families. The flora showed ninety-one herbs, twelve shrubs, fifteen climbers and thirteen trees in the study area. The vegetation in Chavakkad Beach showed 3 endemic species, 1 vulnerable species, 39 weeds, 17 invasive, 62 medicinal and 34 exotic plants. *Indigofera uniflora* Buch. Ham. ex Roxb., *Spermacoce hispida* L. and *Wedelia urticaefolia* (Blume) DC. were the endemic plants and *Agave vivipara* L. were the vulnerable species found in the study area during the period of investigation. *Ipomoea pes-caprae* (L.) R. ssp. *pes-caprae* Gamble, *Spinifex littoreus* (Burm. f.) Merr., *Wollastonia biflora* (L.) DC., *Derris trifoliata* Lour., *Canavalia maritima* (Aubl.) Thouars, *Gisekia pharnaceoides* L. and *Launaea sarmentosa* (Willd.) Sch. are the plants found near seashore in Chavakkad beach.

## Introduction

The coastal vegetation includes communities of salt tolerant and moderately salt tolerant plants. The dry coastal communities are of two types namely sandy strand vegetation and rocky strand vegetation (Banerjee *et al.,* 2002).

The plants establishing on coastal sand dunes are subjected to several environmental fluctuations which affect their growth, survival and community structure. The most important factors include temperature, desiccation, low moisture retention, soil erosion, soil salinity, salt spray, changes in organic matter and pH (Arun *et al.,* 1999). Human activities in coastal areas have intensified over the course of the twentieth century (Defeo *et al.,* 2009). Coastal sandy ecosystems are increasingly being threatened by human pressure, causing loss of biodiversity, habitat degradation and landscape modifications (Del Vecchio *et al.,* 2015). The coastal ecosystems provide large number of assistances to local communities and the global environment (Duarte *et al.,* 2013).

The present investigation undertook to evaluate the status of the plant biodiversity in Chavakkad beach, Thrissur District, Kerala, India. Chavakkad beach is an important tourist spot in Kerala, lying on the coast of Arabian Sea

and situated 5km from Guruvayoor and is one of the best beaches along the West Coast. Chavakkad beach is sandy type with particle size ranges from 0.08-4.6mm.

## Materials and Methods

The study area lies between latitude 10° 36' N to 10° 31' 30"N longitude 76° 0' East to 76° 3' 0" East (Fig. 1). Along the beach 2 sites were selected and are represented as $S_1$ and $S_2$. Site 1 ($S_1$) is Jumeirah Beach and this site is located at 10º 34' 18.0" N 76º 00' 35.8" E; and is very near to the commercial section of Chavakkad beach (Fig. 2). The Jumeirah Beach is located about 2.5 km West to Chettuva lighthouse. Site 2 ($S_2$) is Thottappu Beach and this site is located at 10º 34' 18.1" N 76º 00' 35.8' E, at Thottappu, Chavakkad (Fig. 3). It is almost 1.9 km towards south side of site 1 and 1km North to Chettuva lighthouse. Artificial sea wall is present here, which is partly broken after flood that happened in August 2018 in Kerala.

The present study was conducted from November 2018 to October 2019. The field trips are arranged periodically and the plants were collected along with its inflorescence and fruits. The height of plant, habit, distance of plants from beach and other details were noted on the field book at the time of collection. The photographs of plants were taken by using 20.1 Megapixel digital camera during the period of collection.

Plants in the study area were identified with the help of standard floras available (Gamble & Fischer, 1915-1936; Manilal & Sivarajan, 1982; Sasidharan, 2011; Sasidharan & Sivarajan, 1996; Sreekumar & Nair, 1991). The identified plants were recorded with family, genus and species names.

## Results and Discussion

The present investigation documented 131 species of plants belonging to 106 genera under 40 families (Table 1). Out of 131 plants, 108 species are dicotyledons belonging to 88 genera under 35 families and 23 species are monocotyledons belonging to 18 genera under 5 families. The flora showed ninety-one herbs (69.47%), twelve shrubs (9.16%), fifteen climbers (11.45%) and thirteen trees (9.92%) in the study area. The present investigation identified 98 species of plants from site 1 and 75 species of plants from site 2. More diversity of plants was found in site 1. 42 species of plants were common in both site 1 and site 2 (Table 1).

*Indigofera uniflora* Buch. Ham. ex Roxb., *Spermacoce hispida* L. and *Wedelia urticaefolia* (Blume) DC. were the endemic plants found in study area (Sasidharan, 2011). *Agave vivipara* L. is listed as a vulnerable plant under criteria B1ab (iii) in the IUCN red list of threatened species (Garcia-Mendoza and Giraldo-Canas, 2020). *Ipomoea pes-caprae* (L.) R. ssp. *pes-caprae* Gamble, *Spinifex littoreus* (Burm. f.) Merr., *Wollastonia biflora* (L.) DC., *Derris trifoliata* Lour., *Canavalia maritima* (Aubl.) Thouars, *Gisekia pharnaceoides* L. and *Launaea sarmentosa* (Willd.) Sch. are the plants found near seashore in Chavakkad beach.

*Amaranthus hybridus* L., *Benincasa hispida* (Thunb.) Cogn., *Brassica juncea* (L.) Czern. & Coss., *Cocos nucifera* L., *Cucumis melo* L., *Gliricidia sepium* (Jacq.) Kunth *ex* Walp., *Hibiscus sabdariffa* L., *Lycopersicum esculentum* Mill., *Mangifera indica* L., *Nephelium lappaceum* L., *Sesbania grandiflora* (L.) Poir., *Tamarindus indica* L. and *Terminalia catappa* L. are the cultivated plants found in Chavakkad beach during the period of investigation. *Azadirachta indica* A. Juss., *Casuarina equisetifolia* L., *Racosperma auriculiforme* (Benth.) Pedley were planted in the area. *Agave vivipara* L., *Clitoria ternatea* L. var. *ternatea* Hook. and *Portulaca grandiflora* Hook. f. were the garden plants found in the area.

Out of 131 species identified from study area 62 species are medicinally important plants. Medicinal plants provide easily accessible and relevant resources for primary health care with minimum side effects. These medicinal plants are used for ayurvedic formulations (Warrier *et al.,* 1996). Some of the medicinal plants namely *Sida cordifolia* L., *Cleome viscosa* L., *Triumfetta rhomboidea* Jacq., Ageratum *conyzoides* L., *Scoparia dulcis* L., *Pedalium murex* L., *Acalypha indica* L., *Euphorbia hirta* L., *Micrococca mercurialis* (L.) Benth., *Cyperus rotundus* L. ssp. *rotundus* Hook, *Kyllinga nemoralis* (J. R & G. Forst.) Dandy ex Hutch. and *Dactyloctenium aegyptium* (L.) P. Beauv. were the weeds.

The study area contains 39 species of weeds of which 17 were invasive plants. 34 exotic plants are identified from the study area. These weeds are the indication of disturbance in the vegetation of the area. The invasion of weeds is considered as the beginning of ecosystem degradation. The invasions of non-native species can both reduce the state's plant biological diversity and impact the animals that depend on a variety of native

plants to survive. The indigenous species are highly vulnerable because their growth and survival are inhibited by invasives (Sankaran *et al.,* 2013).

*Ageratum conyzoides* L., *Alternanthera bettzickiana* (Regel) Voss., *Amaranthus viridis* L., *Calopogonium mucunoides* Desv., *Chromolaena odorata* (L.) King & Robins., *Dactyloctenium aegyptium* (L.) P. Beauv., *Euphorbia hirta* L., *Gomphrena celosioides* Mart., *Hyptis suaveolens* (L.) Poit., *Ipomoea triloba* L., *Passiflora foetida* L. var. *foetida* Gamble, *Pennisetum polystachyon* (L.) Schult., *Scoparia dulcis* L., *Spermacoce latifolia* Aubl., *Synedrella nodiflora* (L.) Gaertn. and *Tridax procumbens* L. were the exotic weeds found in the Chavakkad beach during the period of study.

The relative importance of families in a flora is usually expressed by tabulating the largest ten families in the order of their number of species and comparing it with those of the floras of the country (Manilal & Sivaranjan, 1982). Fabaceae (Leguminosae) is the largest family with 17 genera and 18 species followed by Poaceae with 12 genera and 13 species and Asteraceae with 11 genera and 11 species in the present study.

The flora of Madras Presidency (Gamble & Fischer, 1915-1936), Flora of Calicut (Manilal & Sivarajan, 1982) and Flora of Thrissur Forests (Sasidharan & Sivarajan, 1996) also reported Family Fabaceae as the first dominant family and second dominant family as Poaceae in their floras. The largest families depend on the special climatic conditions of the area concerned. EIACP resource partner on biodiversity (flora), Botanical Survey of India, reported 969 species of coastal plants from the Indian coast belonging to 549 genera under 126 families. The coastal plant diversity in Kerala consists of 595 species belonging to 376 genera and 105 families (http://www.bsienvis.nic.in).

Balasubramanian and Azeez (2012) reported 160 Angiosperm plants coming under 56 families from the Pathiramanal Island in Vembanad Lake, an important mangrove location in Kerala. They reported 53 species of trees, 22 shrubs, 73 herbs and 12 climbers. The diverse plant family is Poaceae represented by 13 species followed by Cyperaceae with 12 species and Fabaceae with 11 species. Radhakrishnan *et al.,* (2016) reported 14 edible species, 176 medicinal herbs and 14 fodder yielding plants species from the coastal wards of Thiruvananthapuram district, Kerala.

Sea level fluctuation, erosion, sedimentation, pollution, artificial building up of sea wall and tidal surges bring about dynamic changes in shore line. The vegetation of beach plays an important role in preventing erosion and stabilizing beach.

Apart from that, Olive ridley turtles usually nest in this belt such as Panchavadi, Edakkazhiyur and Akalad beaches in Chavakkad (James *et al.,* 2019). Olive ridley turtles are categorized as vulnerable in the IUCN Red list. The beach plants (Psammophytes) provide habitat for many animal species and are serve as a primary source of food for them.

Coastal flora has a wide range of applications in nutrition, medicine, industry and agriculture. The native people are intimately associated with coastal vegetation for a variety of traditional benefits particularly food, fodder, health, soil fertility and recreation (Sridhar & Bhagya, 2007).

Nowadays, due to population there is a huge pressure on land, forest and aquatic ecosystems. The anthropogenic activities, such as urbanization, encroachment, plantations, hydel projects, transportation and tourism pose considerable degree of threat to the biodiversity. These activities disturb the ecological balance and ultimately resulting in massive destruction of flora and fauna.

The coastal plant diversity survey conducted at Chavakkad Beach revealed a rich and varied flora comprising 131 species from 40 families, including a significant number of medicinal, exotic and invasive plants. The presence of three endemic species and one vulnerable species underlines the ecological importance of the region and fragility of this coastal zone. The presence of weeds, invasive, and exotic species shows disturbances due to human activity, climate change or habitat degradation.

With nearly half the species having medicinal properties, the area has potential for ethnobotanical research and sustainable use. The dominance of herbs and the occurrence of typical shoreline plants also reflect the unique coastal ecosystem. This study provides a baseline inventory for coastal flora of Kerala State which is useful for future monitoring of biodiversity changes and highlights the necessity of sustainable management to protect the ecological integrity of this beach ecosystem.

**Table.1** List of plants in Chavakkad Beach

| Sl. No: | Family | Name of species | Vernacular Name | Habit | Utility | Site No: |
|---|---|---|---|---|---|---|
| **1** | Violaceae | *Hybanthus enneaspermus* (L.) F. Muell. | Orithalthamara | H | | $S_2$ |
| **2** | Brassicaceae | *Brassica juncea* (L.) Czern. | Kaduku | H | E, P | $S_1$ |
| **3** | Portulacaceae | *Portulaca grandiflora* Hook. | Pathumanichedi | H | E, G | $S_2$ |
| **4** | Portulacaceae | *Portulaca oleracea* L. | Manalcheera | H | M | $S_1$ |
| **5** | Portulacaceae | *Portulaca pilosa* L. | Shaggy Portulaca | H | | $S_2$ |
| **6** | Sterculiaceae | *Melochia corchorifolia* L. | Cheruvuram | H | | $S_1$, $S_2$ |
| **7** | Malvaceae | *Hibiscus sabdariffa* L. | Mathipuli | S | E, M, P | $S_1$ |
| **8** | Malvaceae | *Sida acuta* Burm. f. | Anakurunthotti | S | M | $S_1$, $S_2$ |
| **9** | Malvaceae | *Sida alnifolia* L. | Kurunthotti | S | M | $S_1$ |
| **10** | Malvaceae | *Sida cordifolia* L. | Kattooram | S | M, W | $S_1$ |
| **11** | Malvaceae | *Sida fryxellii* Sivar. & Pradeep | - | S | M | $S_2$ |
| **12** | Malvaceae | *Urena lobata* L. | Uthiram | S | | $S_1$ |
| **13** | Capparaceae | *Cleome burmanni* Wight & Arn. | Kattukadugu | H | W | $S_1$, $S_2$ |
| **14** | Capparaceae | *Cleome viscosa* L. | Ariyavela | H | M, W | $S_1$, $S_2$ |
| **15** | Cucurbitaceae | *Benincasa hispida* (Thunb.) Cogn. | Kumbalam | C | P | $S_1$ |
| **16** | Cucurbitaceae | *Cucumis melo* L. | Vellarika | C | P | $S_1$ |
| **17** | Cucurbitaceae | *Mukia maderaspatana* (L.) M. Roem. | Mukkapperam | C | M | $S_1$, $S_2$ |
| **18** | Passifloraceae | *Passiflora foetida* L. | Poochapazham | C | E, IW | $S_1$ |
| **19** | Tiliaceae | *Corchorus aestuans* L. | - | H | M | $S_1$ |
| **20** | Tiliaceae | *Triumfetta rhomboidea* Jacq. | Oorpam | S | M, W | $S_1$, $S_2$ |
| **21** | Oxalidaceae | *Biophytum reinwardtii* (Zucc.) Klotzsch | Mukkutti | H | M | $S_1$, $S_2$ |
| **22** | Anacardiaceae | *Lannea coromandelica* (Houtt.) Merr. | Karasu | T | | $S_1$ |
| **23** | Anacardiaceae | *Mangifera indica* L. | Maavu | T | P | $S_2$ |
| **24** | Meliaceae | *Azadirachta indica* A. Juss. | Ariyaveppu | T | E, M | $S_1$ |
| **25** | Sapindaceae | *Nephelium lappaceum* L. | Rambutan | T | E, P | $S_1$ |
| **26** | Fabaceae - Papilionoideae | *Abrus precatorius* L. | Kunnikuru | C | M | $S_1$ |
| **27** | Fabaceae - Papilionoideae | *Alysicarpus vaginalis* (L.) DC. | Nila Orila | H | | $S_2$ |
| **28** | Fabaceae - Papilionoideae | *Calopogonium mucunoides* Desv. | - | C | E, IW | $S_1$ |
| **29** | Fabaceae - Papilionoideae | *Canavalia maritima* Thouars | Manal amara | C | | $S_1$, $S_2$ |
| **30** | Fabaceae - Papilionoideae | *Clitoria ternatea* L. | Sankupushpam | C | E, G, M | $S_2$ |
| **31** | Fabaceae - Papilionoideae | *Crotalaria linifolia* L.f. | - | H | | $S_2$ |
| **32** | Fabaceae - Papilionoideae | *Derris trifoliata* Lour. | Kammattivalli | C | M | $S_1$, $S_2$ |

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| **33** | Fabaceae - Papilionoideae | *Desmodium triflorum* (L.) DC. | Nilamparanda | H | M | $S_1$, $S_2$ |
| **34** | Fabaceae - Papilionoideae | *Gliricidia sepium* (Jacq.) Kunth | Seemakonna | T | P | $S_1$ |
| **35** | Fabaceae - Papilionoideae | *Indigofera hirsuta* L. | - | H | | $S_2$ |
| **36** | Fabaceae - Papilionoideae | *Indigofera uniflora* Buch. Ham. *ex* Roxb. | Chuvannamaneli | H | | $S_2$ |
| **37** | Fabaceae - Papilionoideae | *Pueraria phaseoloides* (Roxb.) Benth. | Thotta-payar | C | E, IW | $S_1$, $S_2$ |
| **38** | Fabaceae - Papilionoideae | *Rothia indica* (L.) Druce | - | H | | $S_2$ |
| **39** | Fabaceae - Papilionoideae | *Sesbania grandiflora* (L.) Poir. | Agathicheera | T | E, IW, M, P | $S_1$ |
| **40** | Fabaceae - Papilionoideae | *Zornia gibbosa* Span. | Murikutti | H | | $S_2$ |
| **41** | Fabaceae - Caesalpinioideae | *Tamarindus indica* L. | Kolpuli | T | E, M, P | $S_1$, $S_2$ |
| **42** | Fabaceae - Mimosoideae | *Mimosa pudica* L. | Thottavaadi | H | E, IW, M | $S_2$ |
| **43** | Fabaceae - Mimosoideae | *Racosperma auriculiforme* (Cunningham ex Benth.) Pedley | Acacia | T | E, IW | $S_1$ |
| **44** | Combretaceae | *Terminalia catappa* L. | Badam | T | E, P | $S_2$ |
| **45** | Onagraceae | *Ludwigia hyssopifolia* (G. Don) Exell | Neergrampu | H | M | $S_1$ |
| **46** | Onagraceae | *Ludwigia perennis* L. | Neerkarayambu | H | | $S_1$ |
| **47** | Aizoaceae | *Trianthema portulacastrum* L. | Manal vallikeera | H | M | $S_1$ |
| **48** | Molluginaceae | *Gisekia pharnaceoides* L. | Manalkeera | H | | $S_2$ |
| **49** | Molluginaceae | *Glinus oppositifolius* (L.) Aug. DC. | Kaippujeerakam | H | | $S_1$, $S_2$ |
| **50** | Molluginaceae | *Mollugo pentaphylla* L. | Parpadakapullu | H | M | $S_1$, $S_2$ |
| **51** | Rubiaceae | *Mitracarpus hirtus* (L.) DC. | Thaval | H | E, W | $S_2$ |
| **52** | Rubiaceae | *Oldenlandia corymbosa* L. var. *corymbosa* L. | Onathumba | H | M | $S_1$, $S_2$ |
| **53** | Rubiaceae | *Oldenlandia diffusa* (Willd.) Roxb. | Parpadakam | H | | $S_1$ |
| **54** | Rubiaceae | *Oldenlandia herbacea* (L.) Roxb. | Monganampullu | H | M | $S_1$ |
| **55** | Rubiaceae | *Spermacoce articularis* L. f. | Natthachuri | H | | $S_1$, $S_2$ |
| **56** | Rubiaceae | *Spermacoce hispida* L. | Tharthavel | H | | $S_1$ |
| **57** | Rubiaceae | *Spermacoce latifolia* Aubl. | Vellathavara | H | E, W | $S_1$ |
| **58** | Asteraceae | *Ageratum conyzoides* L. | Appa | H | E, IW, M | $S_1$, $S_2$ |
| **59** | Asteraceae | *Blumea axillaris* (Lam.) DC. | - | H | | $S_2$ |
| **60** | Asteraceae | *Chromolaena odorata* (L.) R. M. King & H. Rob. | Communist-pacha | S | E, IW | $S_1$, $S_2$ |
| **61** | Asteraceae | *Eclipta prostrata* (L.) L. | Kanjunni | H | M | $S_1$ |
| **62** | Asteraceae | *Emilia sonchifolia* (L.) DC. | Muyalchevian | H | M | $S_1$, $S_2$ |
| **63** | Asteraceae | *Launaea sarmentosa* (Willd.) | Kadalkozhuppa | H | M | $S_2$ |

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| **64** | Asteraceae | *Synedrella nodiflora* (L.) Gaertn. | Mudianpacha | H | E, IW | $S_1$, $S_2$ |
| **65** | Asteraceae | *Tridax procumbens* L. | Kumminnippacha | H | E, IW | $S_1$, $S_2$ |
| **66** | Asteraceae | *Vernonia cinerea* (L.) Less. | Puvankurunal | H | M | $S_1$, $S_2$ |
| **67** | Asteraceae | *Wedelia urticifolia* (Blume) DC. | - | H | | $S_2$ |
| **68** | Asteraceae | *Wollastonia biflora* (L.) DC. | - | H | | $S_1$, $S_2$ |
| **69** | Sapotaceae | *Madhuca neriifolia* (Moon) H. J. Lam. | Iluppa | T | | $S_2$ |
| **70** | Asclepiadaceae | *Calotropis gigantea* (L.) W. T. Aiton | Erikku | S | M | $S_1$ |
| **71** | Asclepiadaceae | *Wattakaka volubilis* (L. f.) Stapf. | Vattakaakkakkoti | C | M | $S_1$, $S_2$ |
| **72** | Boraginaceae | *Heliotropium indicum* L. | Thelkada | H | M | $S_1$ |
| **73** | Convolvulaceae | *Hewittia malabarica* (L.) Suresh | Ohanamvalli | C | M | $S_2$ |
| **74** | Convolvulaceae | *Ipomoea sepiaria* Seem. | Thiruthali | C | M | $S_1$ |
| **75** | Convolvulaceae | *Ipomoea pes-caprae* (L.) R. Br. | Adambu | H | M | $S_1$, $S_2$ |
| **76** | Convolvulaceae | *Ipomoea pes-tigridis* L. | Naripadam | C | M | $S_1$, $S_2$ |
| **77** | Convolvulaceae | *Ipomoea triloba* L. | Chutti thiruthali | C | E, W | $S_1$ |
| **78** | Convolvulaceae | *Xenostegia tridentata* (L.) D. F. Austin & Staples | Prasarani | H | M | $S_2$ |
| **79** | Solanaceae | *Lycopersicum esculentum* Mill. | Tomato | H | E, P | $S_1$ |
| **80** | Solanaceae | *Physalis angulata* L. | Njottanjodiyan | H | E, IW, M | $S_1$ |
| **81** | Acanthaceae | *Asystasia gangetica* (L.) T. Anderson | Upputhali | H | | $S_2$ |
| **82** | Scrophulariaceae | *Lindernia crustacea* (L.) F. Muell. | - | H | M, W | $S_2$ |
| **83** | Scrophulariaceae | *Scoparia dulcis* L. | Kallurukki | H | E, M, W | $S_1$, $S_2$ |
| **84** | Lamiaceae | *Hyptis suaveolens* (L.) Poit. | Nattapoochedi | S | E, IW | $S_1$, $S_2$ |
| **85** | Lamiaceae | *Leucas aspera* (Willd.) Link | Thumba | H | M | $S_2$ |
| **86** | Lamiaceae | *Platostoma hispidum* (L.) A. J. Paton | Meenagani | H | | $S_1$, $S_2$ |
| **87** | Pedaliaceae | *Pedalium murex* L. | Kakkamullu | H | M, W | $S_1$, $S_2$ |
| **88** | Casuarinaceae | *Casuarina equisetifolia* L. | Kattadi | T | E | $S_1$, $S_2$ |
| **89** | Amaranthaceae | *Achyranthes aspera* L. | Kadaladi | H | M | $S_2$ |
| **90** | Amaranthaceae | *Aerva lanata* (L.) Juss. *ex* Schult. | Cherula | H | M | $S_1$, $S_2$ |
| **91** | Amaranthaceae | *Alternanthera bettzickiana* (Regel) G. Nicholson | Kozhuppa | H | E, IW, M | $S_1$ |
| **92** | Amaranthaceae | *Alternanthera sessilis* (L.) DC. | Kozhuppacheera | H | M | $S_1$ |
| **93** | Amaranthaceae | *Alternanthera tenella* Colla. | - | H | M | $S_1$ |
| **94** | Amaranthaceae | *Amaranthus hybridus* L. | Cheera | H | P | $S_1$ |
| **95** | Amaranthaceae | *Amaranthus viridis* L. | Kuppacheera | H | E, W | $S_1$ |
| **96** | Amaranthaceae | *Gomphrena celosioides* Mart. | Neervadamalli | H | E, IW | $S_2$ |
| **97** | Nyctaginaceae | *Boerhavia diffusa* L. | Thazhuthama | H | M | $S_1$, $S_2$ |
| **98** | Euphorbiaceae | *Acalypha indica* L. | Kuppameni | H | M, W | $S_1$ |
| **99** | Euphorbiaceae | *Croton bonplandianus* Baill. | - | H | IW | $S_1$ |
| **100** | Euphorbiaceae | *Euphorbia hirta L.* | Nilappala | H | E, M, W | $S_1$ |

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| **101** | Euphorbiaceae | *Euphorbia thymifolia L.* | Chitrapala | H | M | $S_1$ |
| **102** | Euphorbiaceae | *Micrococca mercurialis* (L.) Benth. | Kunukku-thooki | H | M, W | $S_1$ |
| **103** | Euphorbiaceae | *Microstachys chamaelea* (L.) Mull. Arg. | Kodiyavannakku | H | M | $S_2$ |
| **104** | Euphorbiaceae | *Phyllanthus amarus* Schumach. & Thonn. | Keezharnelli | H | M | $S_1$, $S_2$ |
| **105** | Euphorbiaceae | *Phyllanthus reticulatus* Poir. | Neeroli | S | | $S_1$ |
| **106** | Moraceae | *Ficus benghalensis* L. | Peraal | T | E, M | $S_1$ |
| **107** | Urticaceae | *Laportea interrupta* (L.) Chew. | Choriyanam | H | | $S_1$ |
| **108** | Urticaceae | *Pouzolzia zeylanica* (L.) Benn. | Kallurukki | H | M | $S_1$, $S_2$ |
| **109** | Arecaceae | *Cocos nucifera* L. | Thengu | T | M, P | $S_1$, $S_2$ |
| **110** | Agavaceae | *Agave vivipara* L. | - | S | E, G | $S_2$ |
| **111** | Commelinaceae | *Commelina benghalensis* L. | Adakkavettila | H | M | $S_1$, $S_2$ |
| **112** | Commelinaceae | *Cyanotis axillaris* (L.) D. Don. | - | H | | $S_1$ |
| **113** | Commelinaceae | *Cyanotis cristata* (L.) D. Don. | - | H | | $S_1$, $S_2$ |
| **114** | Cyperaceae | *Cyperus compressus* L. | - | H | | $S_1$ |
| **115** | Cyperaceae | *Cyperus cyperinus* (Retz.) Valck. Sur. | - | H | | $S_1$ |
| **116** | Cyperaceae | *Cyperus distans* L.f. | - | H | | $S_1$ |
| **117** | Cyperaceae | *Cyperus rotundus* L. subsp. *rotundus* L. | Kuzhimuthanga | H | M, W | $S_1$ |
| **118** | Cyperaceae | *Kyllinga nemoralis* (J. R Forst & G. Forst.) Dandy | Vallimuthanga | H | M, W | $S_2$ |
| **119** | Poaceae | *Alloteropsis cimicina* (L.) Stapf | - | H | W | $S_1$ |
| **120** | Poaceae | *Aristida setacea* Retz | - | H | | $S_2$ |
| **121** | Poaceae | *Axonopus compressus* (Sw.) P. Beauv | Kaalappullu | H | | $S_1$ |
| **122** | Poaceae | *Cynodon dactylon* (L.) Pers. | Karuka | H | M | $S_1$, $S_2$ |
| **123** | Poaceae | *Dactyloctenium aegyptium* (L.) Willd | Kavarapullu | H | E, M, W | $S_1$, $S_2$ |
| **124** | Poaceae | *Echinochloa colona* (L.) Link | Kavada | H | | $S_2$ |
| **125** | Poaceae | *Eleusine indica* (L.) Gaertn. | Kattuthina | H | W | $S_1$, $S_2$ |
| **126** | Poaceae | *Eragrostis unioloides* (Retz.) Nees *ex* Steud. | Karayampullu | H | W | $S_1$ |
| **127** | Poaceae | *Ischaemum indicum* (Houtt.) Merr. | Chenkodipullu | H | W | $S_2$ |
| **128** | Poaceae | *Pennisetum pedicellatum* Trin. | Poochavalanpullu | H | IW | $S_1$ |
| **129** | Poaceae | *Pennisetum polystachyon* (L.) Schult. | - | H | E, IW | $S_1$ |
| **130** | Poaceae | *Spinifex littoreus* (Burm. f.) Merr. | Ravana-meesa | H | | $S_1$ |
| **131** | Poaceae | *Sporobolus tenuissimus* (Mart. ex Schrank) Kuntze | - | H | W | $S_1$, $S_2$ |

C – Climbers, H – Herbs, S – Shrubs, T – Trees, E – Exotic plants, G – Garden plants,
M – Medicinal plants, P – Cultivated plants, I – Invasive weeds, W – Weeds

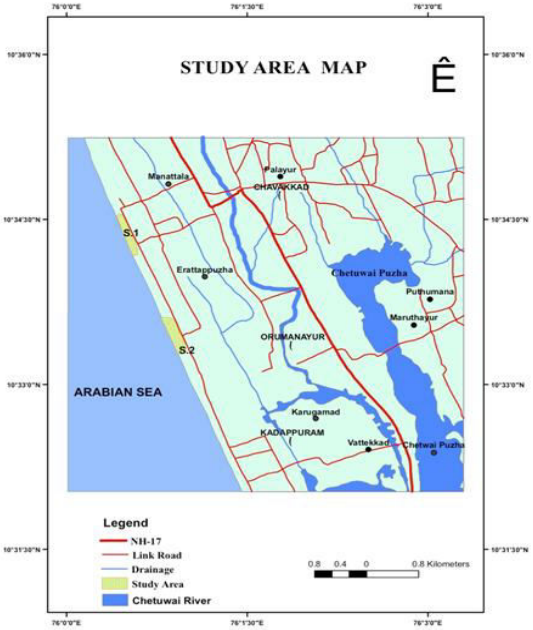


Fig. 1. Map showing sites in Chavakkad Beach

Fig. 2. Site 1 ($S_1$) – Jumeirah Beach

Fig. 3. Site 2 ($S_2$) – Thottappu Beach

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## Author Contributions

Sareena P. Mohamed: Conceived the original idea, Designed the model, Formal Analysis, Investigation and wrote the draft manuscript.; P. Tessy Paul: Methodology, Resources, Analyzed the data, Review & Editing, Supervision, Project Administration and Funding Acquisition.; Joshy K. Simon: Methodology, Resources, Analyzed the data, Review & Editing, Supervision

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## Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethical Approval** Not applicable.

**Consent to Participate** Not applicable.

**Consent to Publish** Not applicable.

**Conflict of Interest** The authors declare no competing interests.

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