



ISSN (E): 2320-3862
ISSN (P): 2394-0530
<https://www.plantsjournal.com>
JMPS 2023; 11(6): 119-126
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Received: 01-10-2023
Accepted: 04-11-2023

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An Inventory of wetland plants with medicinal properties in Kenya

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DOI: <https://doi.org/10.22271/plants.2023.v11.i6b.1614>

Abstract

There is absence of information on biodiversity of wild medicinal plants in wetlands across the world. This study therefore, documented the wild medicinal plants of wetlands in Kenya. The study was conducted through secondary data and scoping review methodology. A total of 122 species of medicinal plant in 42 families were reported previously. Most of medicinal plants in wetlands belong to the family Fabaceae (16), Asteraceae (14), Euphorbiaceae (10) and Lamiaceae (7). The medicinal plants were mostly used in treatment of diarrhea (46), general and unspecified ailments (42), fever (37) and chest problems (32), eye problem (32), typhoid (29) and asthma (28). Finally, the most commonly used part of the plants were roots, stems, leaves and branches. Undertaking a comprehensive inventory of wetland medicinal plants is recommended as a strategy to provide the missing information that would encourage conservation of wetlands as potential source of medicinal plants.

Keywords: Wetlands, wetland utilization, medicinal plants, plant biodiversity conservation, Kenya

1. Introduction

Wetland are defined by Ramsar Convention as "Areas of marsh, fen peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six metres (Ribbe *et al.*, 2024) ^[48]. These areas include lands that are permanently or occasionally waterlogged with fresh, saline, brackish or marine waters at a depth not exceeding six meters. These areas may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Gerbeaux *et al.*, 2018; Richardson *et al.*, 2022) ^[14, 49]. Thus wetlands exist in the forms of bogs, floodplains, marshes, shallow lakes, swamps, ox-bow lakes as well as river meanders which support plant growth (Halls, 1997; Amler *et al.*, 2015; Gxokwe *et al.*, 2020) ^[16, 5, 15]. In Kenya the definition of wetlands condidter it as "areas of land that are permanently, seasonally or occasionally waterlogged with fresh, saline, brackish or marine waters, including both natural and man-made areas that support plants and animals" (Harmsen, 2018) ^[17]. The size of wetlands in Kenya is estimated at cover between 3 to 6% of the landmass (14,000 km²) (Njuguna and Howard, 1992) ^[40]. Based on the Ramsar convention, wetlands in Kenya can either be inland, marine or coastal with some man-made wetlands also considered. The inland wetlands are the riverine and lacustrine, palustrine while the marine wetlands in estuaries (Njuguna and Howard, 1992; Sakané *et al.*, 2011) ^[40, 52]. A survey of wetlands in Kenya classified them further based on size and the larger wetlands include wide range of lakes such as L. Amboseli L. Baringo, L. Chala, L. Elementaita, L. Jipe, L. Kanyaboli, L. Magadi, L. Naivasha, L. Nakuru, L. Ol'Bolossat as well as the near the edges of L. Victoria. There are also notable swamps in Kenya such as Lorian, Saiwa, Shompole and Yala. Meanwhile the coastal wetlands are mangroves swamps, sea grassbeds and coral reefs. Numerous man made wetlands in Kenya occur in Mwea, Ahero, Bunyala irrigation schemes as well as in Kenya hydroelectric power stations located in Gitaru, Masinga, Kamburu, Kiambere Kindaruma, Sagana, and the Grand Falls Mutonga.

The significance of wetlands in providing ecological, environmental and socio-economic, benefits is clear (Nkako, 1992; Brander *et al.*, 2013) ^[41, 8]. Wetland also double as reservoir for plant biodiversity preserving important plant genetic resources (Zedler and Kercher, 2004; Magee *et al.*, 2019) ^[59, 26]. While the role of wetlands in plant diversity conservation has continued to be advocated, fewer studies are dedicated to understanding of the plant biodiversity in wetlands of Kenya (Alvarez *et al.*, 2012) ^[4].

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Moreover, utilization of medicinal plants from wild is receiving more attention and wetland roles continue to be emphasized (Srivastava, 2018) [55]. Ethnopharmacognosy and herbal medicines from the wild including in wetlands are being recommended and promoted as herbal remedies for a number of diseases especially in rural areas where conventional medicines are expensive and out of reach of many folks (Chen *et al.*, 2016; Rathore and Mathur, 2018) [10, 47]. This is particularly true in many parts of rural Kenya including those areas near wetlands (Dar *et al.*, 2017; Amzat and Razum, 2018; Zhang *et al.*, 2018) [12, 7, 61]. However, there is paucity of studies in medicinal plants in wetlands of Kenya. Therefore the study documented medicinal plant species in the wetlands of Kenya.

2. Methodology

This study combined both secondary data and scoping review methodology. The secondary data sources were obtained from varied source such as books, peer reviewed journals, online MSc and PhD theses. They were also sourced from electronic databases from online libraries, science direct, Web of Science, African Journal online, as well as from the websites of local Kenyan universities and government.

Scoping review was conducted to gather evidence based synthesis (Peterson *et al.*, 2017) [46] by providing an summary of literature pertaining to a specific topic with a view to recognize patterns, directions, data clusters, as well as gaps. It has been found to be important for expansive, versatile questions, which is useful for comprehensively follow-up research based on unraveled facts (Munn *et al.*, 2018) [34]. Searches were conducted utilizing common terms such as wetlands, medicinal plants, Kenya, and other related terms. The articles used were between 1990 and 2023.

3. Results

3.1. Diversity of Medicinal Plants in wetlands

Most studies available in Kenya have looked at the overall plant diversity in several ecosystems but inventory of wetland medicinal has rarely been undertaken. Therefore during the study, we used the information on overall plant diversity conducted in various wetland ecosystem to document those with medicinal properties. This method may however, underestimate the medicinal plants found in the wetlands. Among the published studies of medicinal plants in Kenyan wetlands, the distribution of wetlands plant species in Kenya is provided in Table 1.

Table 1: Abundance of vascular and plants and plants with medicinal properties in Kenyan wetlands. Values in parenthesis indicate percent of medicinal plants compared to the overall plant abundance.

Wetland	Vascular plant abundance	Medicinal plants	Reference
Hyena Wetland (Nairobi National Park)	32	5 [15.3]	(Ruto <i>et al.</i> , 2012) [51]
Nalogomon Wetland	28	11 [39.3]	(Ruto <i>et al.</i> , 2012) [51]
Lake Victoria Wetland	36	14 [38.9]	(Crisman, 2001) [11]
Ewaso Narok floodplain	206	24 [11.7]	(Alvarez <i>et al.</i> , 2012) [4]
Tegu (Mt. Kenya)	188	28 [14.9]	(Alvarez <i>et al.</i> , 2012) [4]
Marula	122	31 [25.4]	(Mulei <i>et al.</i> , 2016) [32]
Leseru	176	25 [14.2]	(Mulei <i>et al.</i> , 2016) [32]
Singilai	115	44 [12.2]	(Mulei <i>et al.</i> , 2016) [32]
Chepkongony	99	24 [24.2]	(Mulei <i>et al.</i> , 2016) [32]
Nyando floodplain wetland	30	5 [16.7]	(Rongoei <i>et al.</i> , 2014) [50]
Lake Nakuru	575	122 [21.2]	(Mutangah, 1994) [36]
Lake Naivasha Wetland	45	12 [26.7]	(Harped <i>et al.</i> , 1995) [18]
Loboi Swamp	36	10 [27.8]	(Muasya <i>et al.</i> , 2004) [31]
Wetlands of Uasin Gishu	50	15 [30.0]	(Mulei <i>et al.</i> , 2014) [33]
Saiwa Swamp	32	11 [32.3]	(Akwee <i>et al.</i> , 2010) [2]

The families and species abundance of each family of the medicinal plant are shown in Table 2. The species name in each family within the wetlands of Kenya is shown in Table 3. A total of 122 species of medicinal plant in 42 families were reported previously. The family of Fabaceae had the highest number of plant species with potential medicinal importance (16). This was followed by families Asteraceae

(14), Euphorbiaceae (10) and Lamiaceae (7). Families such as Araliaceae, Asparagaceae, Asphodelaceae (Liliaceae), Basellaceae, Chrysomelidae, Cucurbitaceae, Cupressaceae, Cyperaceae, Hypericaceae, Myricaceae, Opiliaceae, Piperaceae, Proteaceae, Ranunculaceae, Rhizophoraceae, Salvadoraceae, Urticaceae were each represented by only single species.

Table 2: Plant families and their numbers of medicinal plant species in Kenyan wetlands

Family	Number of species
Acanthaceae	3
Amaranthaceae	3
Anacardiaceae	3
Apocynaceae	2
Araliaceae	1
Asparagaceae	1
Asphodelaceae (Liliaceae)	1
Asteraceae	14
Basellaceae	1
Bignoniaceae	2
Capparaceae	5

Chrysomelidae	1
Cucurbitaceae	1
Cupressaceae	1
Cyperaceae	1
Euphorbiaceae	10
Fabaceae	16
Hypericaceae	1
Lamiaceae	7
Malvaceae	5
Meliaceae	4
Moraceae	1
Myricaceae	1
Myrtaceae	2
Oleaceae	3
Oxalidaceae	2
Piperaceae	1
Poaceae	2
Proteaceae	1
Ranunculaceae	1
Rhamnaceae	3
Rhizophoraceae	1
Rosaceae	3
Rubiaceae	4
Salicaceae	3
Salvadoraceae	1
Sapindaceae	2
Solanaceae	4
Urticaceae	1
Vitaceae	2
Zygophyllaceae	1
Total	122

Table 3: Most common medicinal plants species identified and the family in the Kenya wetlands. Authority in round brackets, while common name in square/box brackets

Family	Botanical Name
Acanthaceae	<i>Acanthus eminens</i> (C.B.Cl.) [Bear's breeches], <i>Justicia flava</i> (Vahl) [water willow], <i>Hypoestes forskalii</i> (Vahl) R.Br
Amaranthaceae	<i>Achyranthes aspera</i> (L.) [Devil's horsewhip], <i>Amaranthus spinosus</i> (L.) [Amaranth], <i>Chenopodium opulifolium</i> (Koch & Ziz) [pigweeds]
Anacardiaceae	<i>Lannea schweinfurthii</i> (Engl.) [False Valley floor], <i>Ozoroa insignis</i> (Delile) [Currant Resin Tree], <i>Rhus natalensis</i> (Berhn. ex Krauss) [Natal rhus],
Apocynaceae	<i>Calotropis procera</i> (Ait f.) [Rubber bush], <i>Carrisa edulis</i> (Vahl). [Simple-spined num-num]
Araliaceae	<i>Cussonia spicata</i> (Thunb) (Spiked cabbage tree)
Asparagaceae	<i>Asparagus falcatus</i> (L.) [Druce]
Asphodelaceae (Liliaceae)	<i>Aloe tweediae</i> (Christian) [Chinese aloe]
Asteraceae	<i>Artemisia afra</i> (Jacq ex Willd.) [African wormwood], <i>Aspilia pluriseta</i> (Schweinf.) [Dwarf aspilia] <i>Bidens pilosa</i> (L.) [Blackjack], <i>Ethulia scheffleri</i> (S. Moore) [Not reported] <i>Gutenbergia cordifolia</i> (Benth.) [Daisy] <i>Launaea cornuta</i> (Oliv and Hiern, C. Jeffrey) [Bitter lettuce], <i>Microglossa pyrifolia</i> (Lam. O. Kuntze) [-], <i>Psiadia arabica</i> Jaub. & Pach [-], <i>Solanecio mannii</i> (Hook. f.C. Jeffrey) [Mulagara, Murhagala, Mutaala], <i>Sphaeranthus suaveolens</i> (Forsk.) DC [Hardheads], <i>Tithonia diversifolia</i> (Hemsl. Gray) [tree marigold], <i>Tridax procumbens</i> (L.) [coatbuttons], <i>Vernonia auriculifera</i> (Welw. Hiern) [bitterleaf], <i>Vernonia brachycalyx</i> (O. Hoffm. Lasiopa Lam) [Ironweed]
Basellaceae	<i>Basella alba</i> (L.) [Red Indian Spinach]
Bignoniaceae	<i>Kigelia africana</i> (Lam. Benth.) [Sausage tree], <i>Markhamia lutea</i> (Benth. K. Schum.) [Nile tulip]
Capparaceae	<i>Capparis fascicularis</i> (DC.) [zigzag caper-bush] <i>Boscia angustifolia</i> (A. Rich.) [Rough-leaved shepherds tree], <i>Cadaba farinosa</i> (Forssk.) [herd-boy's fruit] <i>Cleome gynandra</i> (L.) [Spiderwisp], <i>Crateva adansonii</i> (DC.) [Caper tree]
Chrysomelidae	<i>Afrocrania volkensisii</i> (Harms. Hutch.) (Dogwood)
Cucurbitaceae	<i>Momordica foetida</i> (Schum. & Thonn) [Bad smell melon]
Cupressaceae	<i>Juniperus procera</i> (Hochst. Ex Endl.) [African pencil cedar]
Cyperaceae	<i>Cyperus esculentus</i> (L.) [Nutsedge]
Euphorbiaceae	<i>Clutia abyssinica</i> (Jaub. & Spach) [Smooth-fruited lightning-bush], <i>Croton macrostachyus</i> (Hochst. ex Delile.) [Broad-leaved croton], <i>Croton megalocarpoides</i> (Friis & M.G. Gilbert) [Croton wood/musine], <i>Euphorbia candelabrum</i> Kotschy [Candelabra euphorbia], <i>Euphorbia inaequilatera</i> (Sond.) [Smooth creeping milkweed] <i>Euphorbia tirucalli</i> (L.) [Indian tree spurge], <i>Flueggea virosa</i> (Roxb.ex Willd. Royle) [Chinese waterberry], <i>Phyllanthus sepialis</i> (Müll. Arg.) [-], <i>Ricinus</i>

	<i>communis</i> (L.) [Castor-oil plant], <i>Sapium ellipticum</i>
Fabaceae	<i>Abrus precatorius</i> (L. Verd.) [Rosary pea], <i>Acacia hockii</i> (De Wild.) [Shittim Wood], <i>Acacia mellifera</i> (Vahl Benth) [blackthorn], <i>Acacia nilotica</i> (L. Willd.ex Delile) [gum arabic tree], <i>Acacia tortilis</i> (Forssk. Hayne) [Umbrella thorn acacia], <i>Albizia coriaria</i> (Welw ex Oliver) [Lightwood], <i>Albizia gummifera</i> (J.F. Gmel.) [peacock flower], <i>Cassia occidentalis</i> (L.) [Coffee senna], <i>Dichrostachys cinerea</i> (L.) [sicklebush], <i>Erythrina abyssinica</i> (Lam. ex DC.) [lucky bean or flame tree], <i>Faidherbia albida</i> (Delile A.Chev.) [Apple-ring acacia], <i>Indigofera arrecta</i> (A. Rich) [Java indigo; Bengal indigo], <i>Senna occidentalis</i> (L. Link) [Coffee senna, antbush, stink weed], <i>Tamarindus indica</i> (L.) [Tamarind, Athel tree], <i>Tylosema fassoglense</i> Kotschy ex Schweinf.) Torre & Hillc.) (Creeping bauhinia), <i>Vachellia nilotica</i> (L. P.J.H. Hutler & Mabb) [Prickly acacia]
Hypericaceae	<i>Harungana madagascariensis</i> (Lam. ex Poir.) [Dragon's blood tree, Orange-milk tree]
Lamiaceae	<i>Ajuga remota</i> (Benth.) [Bugleweed, ground pine], <i>Euclea divinorum</i> (Hiern.) [Diamond leaf], <i>Fuerstia africana</i> (T.C.E.Fr.) [African False Dandelion], <i>Ocimum basilicum</i> (L.) [Sweet Basil], <i>Ocimum kilimandscharicum</i> (Guerke) [Hoary basil, Camphor basil], <i>Plectranthus barbatus</i> (Andrews) [Indian coleus], <i>Rothea myricoides</i> (Hochst. Steane & Mabb) [Butterfly Bush]
Malvaceae	<i>Adansonia digitata</i> (L.) [African baobab], <i>Dombeya torrida</i> (J.F. Gmel. Bamps) [Forest dombeya], <i>Grewia bicolor</i> (Juss.) [bastard brandy bush], <i>Pavonia kilimandscharica</i> (Gurke) [swampmallow], <i>Sida cuneifolia</i> (Roxb) [Common wireweed]
Meliaceae	<i>Azadirachta indica</i> (A. Juss) [neem, margosa, nimtree or Indian lilac], <i>Melia azedarach</i> (L.) [Bead Tree], <i>Melia volkensii</i> (L.) [tree of knowledge], <i>Turraea robusta</i> (Gürke) [African Turraea]
Moraceae	<i>Ficus natalensis</i> (Hochst) [African Fig tree]
Myricaceae	<i>Myrica salicifolia</i> (Hochst. ex A.Rich) [-]
Myrtaceae	<i>Syzygium guineense</i> (Wall) [Water pear, water berry], <i>Eucalyptus globulus</i> (Labil.) [Southern blue gum]
Oleaceae	<i>Jasminum abyssinicum</i> (N.E.Br.) [Forest jasmine], <i>Olea europaea</i> (L.) [Olive tree], <i>Olea capensis</i> (L.) [black ironwood]
Oxalidaceae	<i>Biophytum abyssinicum</i> (Steud ex A.Rich) [Sensitive wood sorrel], <i>Oxalis corniculata</i> (L.) [creeping woodsorrel]
Piperaceae	<i>Piper capense</i> (L.f.) [Wild pepper]
Poaceae	<i>Pennisetum hohenackeri</i> (Hochst. ex Steud [Fountain Grass], <i>Sporobolus stapfianus</i> [Not specified]
Proteaceae	<i>Faurea saligna</i> (Harv.) [African Beechwood]
Ranunculaceae	<i>Clematis simensis</i> Fresen. (Pine hyacinth)
Rhamnaceae	<i>Ziziphus mauritiana</i> (Lam.) [Indian plum, Jujube], <i>Rhamnus prinoides</i> (L.'Herit) [shiny-leaf buckthorn], <i>Scutia myrtina</i> (Burm. f. Kurz) [cat-thorn]
Rhizophoraceae	<i>Cassipourea malosana</i> (Baker Alston) [Onionwood]
Rosaceae	<i>Hagenia abyssinica</i> (Willd.) (African redwood), <i>Rubus steudneri</i> Schweinf. [Forest bramble], <i>Prunus africana</i> (Hook.f. Kalkman) [African chery/Red stinkwood]
Rubiaceae	<i>Canthium schimperianum</i> (A. Rich.) [Psydrax], <i>Gardenia volkensii</i> (K. Schum.) [Common gardenia], <i>Rubia cordifolia</i> (L.) [Indian madder], <i>Vangueria volkensii</i> (K.Schum.) [Volkens' Medlar]
Salicaceae	<i>Dovyalis abyssinica</i> (A. Rich. Warb) (Ceylon gooseberry), <i>Flacourtia indica</i> (Burm. f. Merr.) (Governor's plum/Indian plum), <i>Rimera grandifolia</i> (Hochst.)Warb [wild-mulberry]
Salvadoraceae	<i>Salvadora persica</i> (L.) [Toothbrush tree]
Sapindaceae	<i>Allophylus pervillei</i> (Blume.) [-], <i>Pappea capensis</i> (Spreng Eckl. & Zeyh.) [jacket plum]
Solanaceae	<i>Solanum incanum</i> (L.) [Sodom apple], <i>Solanum nigrum</i> (L.) [Black nightshade], <i>Solanum terminale</i> (Forssk.) [Sodom apple], <i>Withania somnifera</i> (L. Dunal) [Indian Winter cherry]
Urticaceae	<i>Urtica massaica</i> (Mildbr.) [Stinging nettle]
Vitaceae	<i>Cissus quinquangularis</i> (L.) [Five-ribbed Cissus], <i>Rhoicissus tridentata</i> (L.f. Wild & Drum) [Bushmans Grape]
Zygophyllaceae	<i>Balanites glabrus</i> (Mildbr. & Schltr.) [-]

[-] Not reported

3.2. Use Categories with High Numbers of Use Reports per Species

The numbers of wild wetland medicinal plants and the diseases they manage are in Kenya are shown in Table 4.

Most of the wild medicinal plants were used in treatment of diarrhea (46), general and unspecified (42), fever (37) and chest problems (32), eye problem (32), typhoid (29) and asthma (28).

Table 4: numbers of wild wetland medicinal plants and the diseases they manage are in Kenya

Categories	Species	Number of plants used
Arteriosclerosis		15
Arthritis		13
Asthma		28
Backache		23
Blood pressure		15
Chest problems		32
Dental problems		16
Diabetes		25
Diarrhea		46
Eye		32
Fever		37
Flu		26
Gastrointestinal disorders		23
General and unspecified		42
Gonorrhea		7

Gout	5
Gynecological disorders	25
Heartburn	17
Injuries	17
Malaria	21
Meningitis	9
Mumps	18
Musculoskeletal disorders	21
Nutritional disorders	25
Pneumonia	13
Respiratory	18
Rheumatic fever	21
Skin disorders	26
Skin rashes	19
Smallpox	11
Snake bites	16
Stomach ache	26
Tetanus	19
Toothache	14
Trachoma	9
Tuberculosis	22
Typhoid	29
Urological problems	18

The most commonly used parts of the plants are provided in Table 5. Roots, stems, leaves and branches were the most commonly used parts of the wild medicinal plants. Other parts of the plants such as bark, bulb, flower and fruits were not widely utilized.

Table 5: Wetland plants parts used for treatment of diseases

Plant parts used	Number of wild medicinal plants	Percent of the plants species
Roots	88	72.1
Stem	63	51.6
Leaves	42	34.4
Branches	31	25.4
Fruit	28	23.0
Bark	23	18.9
Bulb	12	9.8
Flowers	6	4.9

4. Discussion

There are very few documented studies on inventory of wild medicinal wetland plants of Kenya and by extension in many parts of the world. This study relied on few published works and unpublished reports to decipher these wild medicinal wetland plants. Most of the wild medicinal wetland plants were identified from a general list of plants surveyed and therefore it may underestimate the actual number of wild medicinal plants in the wetlands. Most of the current wild medicinal plants of the Kenyan wetlands were obtained from wetlands of Ewaso Narok floodplain, Tegu (Mt. Kenya) (Alvarez *et al.*, 2012) [4], Hyena Wetland (Nairobi National Park), Nalogomon Wetland (Ruto *et al.*, 2012) [51], Lake Naivasha Wetland (Harped *et al.*, 1995) [18], Lake Nakuru (Mutangah, 1994) [36], Lake Victoria Wetland (Crisman, 2001) [11], Lobo Swamp (Muasya *et al.*, 2004) [31], Marula, Leseru, Singilai Chepkongony (Mulei *et al.*, 2016) [32], Nyando floodplain wetland (Rongoei *et al.*, 2014) [50], Saiwa Swamp (Akwee *et al.*, 2010) [2], and Wetlands of Uasin Gishu (Mulei *et al.*, 2014) [33]. Therefore it is possible to conclude that wild medicinal plant of wetlands in Kenya are yet to be documented, not yet published or the data is simply not available in most online platforms. The number of wild

medicinal plants in wetlands of Kenya was high even with the little published data available. There were a total of 122 species identified as belonging to 42 families of wild medicinal plants in Kenyan wetlands. Among the wetlands, Nalogomon Wetland, Lake Victoria Wetland and Wetlands of Uasin Gishu had up to 30% of the plants being identified as medicinal. Lower human disturbance and plant harvesting among these wetlands may account for the higher abundance than in some of the human impacted landscapes. Although the number of wild medicinal plants may seem to be high compared to medicinal plants in Kenya (Chebii *et al.*, 2022) [9], they are low than most conventional studies of medicinal plants in Kenya (Kipkore *et al.*, 2014; Nankaya *et al.*, 2019; Onyancha *et al.*, 2023) [23, 37, 45] probably due to encroachment, and over-harvesting of these plants species for domestic use.

There is currently no checklist of medicinal wild plants in most wetlands and therefore comparison of the current study with published work within Kenya is limited. However, during our survey, family of Fabaceae had the highest number of plant species with potential medicinal importance (16), followed by families Asteraceae (14), Euphorbiaceae (10) and Lamiaceae (7). These results concur with other studies which document these families as the dominant medicinal plant in Kenya (Kipkore *et al.*, 2014; Ochwang'i *et al.*, 2014; Nankaya *et al.*, 2019) [23, 43, 37]. The current results also show partial agreement with studies on the medicinal plants of Tanzania one of the neighbouring countries which reported Fabaceae, Lamiaceae, and Asteraceae as more dominant families in a survey of medicinal plants in the country (Moshi *et al.*, 2012) [30]. Apart from the high diversity of these families where they can be readily available (Ruto *et al.*, 2012; Moges *et al.*, 2017) [51, 29], there could also be high species utilization for medicinal purpose among the wetland dwellers. Among the screening test done on medicinal plants these plants have also recorded the highest number of phytochemicals that are useful for treatment of various diseases (Obakiro *et al.*, 2020; Van Wyk, 2020; Odukoya *et al.*, 2022) [42, 58, 44]. Reliance on high numbers of medicinal plants in Sub-Saharan African countries is common due to

high cost of conventional medicine among resource poor citizens (Sofowora, 1996; Kakooza-Mwesige, 2015) ^[53, 21].

During the survey, most use records were in the categories diarrhea (46), general and unspecified (42), fever (37) and chest problems (32), eye problem (32), typhoid (29) and asthma (28). These diseases are common ailments in many parts of Kenya and do not require complex drugs to treat and therefore the use of medicinal plants appear to manage them. Occurrence of diarrhea in many countries of Sub Saharan Africa is a common and often associated with outbreaks of cholera causing deaths (Lessler *et al.*, 2018) ^[25]. It is surprising that medicinal plants in the treatment of was low, as it dominate other studies reporting the use of medicinal plants in Kenya and other Sub Saharan African countries (Komlaga *et al.*, 2015; Ngarivhume *et al.*, 2015; Alebie *et al.*, 2017) ^[24, 38, 3]. It was not common among the diseases treated with wetland medicinal plants.

During the survey, roots, stems, leaves and branches were the commonest part of the tree used in medicinal treatments which concurs with other studies in Kenya (Jeruto *et al.*, 2008; Mustafa *et al.*, 2023) ^[20, 35]. The use of roots for medicinal purpose also concur with studies conducted elsewhere in Africa including in Zimbabwe, (Maroyi, 2013) ^[27], Nigeria (Sulaiman *et al.*, 2022) ^[56], Ethiopia (Zerabruk and Yirga, 2012; Teklay *et al.*, 2013) ^[60, 57] and Tanzania (Amri and Kisangau, 2012) ^[6]. Roots have been shown to have higher concentrations of active ingredients that are useful for medicinal purposes (Hussain *et al.*, 2022; Karungamy, 2022) ^[19, 22]. There are also several reports from regions of he African continents that use leaves frequently for herbal remedies (McGaw *et al.*, 2022; Nigussie and Wale, 2022) ^[28, 39]. The leaves are preferred as a result of high concentration of phytochemical compounds possessing a number of medicinal properties (Eleazu *et al.*, 2012; Agidew, 2022) ^[1, 13] as well as the ease of harvesting leaves (Sofowora *et al.*, 2013) ^[54].

5. Conclusions and policy recommendations

During the survey, it was established that the number of wild medicinal plants in wetlands of Kenya was high at 122 species belonging to 42 families of wild medicinal plants in Kenyan wetlands. The distribution was in favour of the family Fabaceae, Asteraceae, Euphorbiaceae and Lamiaceae each having more than 7 species representing the family. This shows that the wetlands of Kenya contain high diversity of wild medicinal plants. The full inventories of medicinal plants in Kenya are however lacking and this is an areas neglected in research. This calls for more research undertakings on the complete wild medicinal inventories of the Kenya wetlands, as well as developing exploitation index to analyze the status of medicinal plants of the wetlands. Undertaking a comprehensive inventory of wild wetland medicinal plants is crucial to obtain a database from which future studies can be pegged.

The wild medicinal plants from the Kenyan wetlands have shown strong tendency to manage diarrhea, general ailments, fever, chest problems, eye problem, typhoid and asthma. There were several disease that these species may treat but limited research was encountered in this realm. However, these diseases are just based on general surveys elsewhere and the diseases they treat. Therefore, there is a need for additional research on ailments treated by the Kenyan wetland medicinal plants.

The study also indicated that roots, stems, leaves and branches were the commonest part of the tree used in

medicinal treatments. The use of roots and leaves may be due to their pharmacological properties and ease of collection. However, harvesting of roots of the plants may lead to destruction of the plants. Therefore there is need to conduct research and establish other parts of the plants containing active phytochemical compounds and can be harvested without destroying the entire plant.

The study did not address the threats of overexploitation of the wild medicinal plants. However, due to the relatively low numbers of the species compared to many studies on medicinal plants in Kenya, may point to the need to protect these plants from overexploitation. This can be achieved through sustainability in the use of the plant resource where the plants may be integrated with other wetland resource and advancing their use for alternative livelihoods for wetland adjacent dwellers. Education to the local community on threats and the need for conservation of the wild wetland plants is highly encouraged.

6. References

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