Checklist of the Flora of Tutti Island, Khartoum Province, Sudan.

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Abstract:

During a field survey conducted between August 2016 to December 2018 the flora of the tutti island has been inventoried. The current study was aimed to inventory and document the flora of Tutti Island. A total of 155 species belong to 120 genera and 41 families were documented to represent the flora of the island. The study inventoried a total number of 135 species belong to Dicotyledonous which belong to 115 genus and 37 families whereas 20 species are monocotyledonous belong to 17 genus and 4 families. The most representative families were Fabaceace (23species), Poaceae(14species), Amaranthaceae(13species), Asteraceae (10species) , Malvaceae (9 species) and Euphorbiaceae(8species) respectively. Herbs comprise the predominant type of growth habit (52.34%) followed by shrubs (30.87%), vines (10.06%) and trees (6.71%) respectively. The study also resulted in a number of species not previously recorded in the flora of the study area. Botanical names of species and families were updated. The inventory of the flora of the study area led to a new generic record to the flora of Sudan; that is *Macroptilium lathyroides* (L.) Urb. This study has shed light on the vascular plants composition of the study area by preparing a check list. The study showed the richness of the island in plant diversity. Also, the study listed a number of plant species that were not previously recorded in flora of the study area. The study noticed that the study area is witnessing some factors that can affect plant diversity over time, these factors represented in some human activities, burning of weeds to clean farms and annual floods of the river Nile.

Key words: Dicotyledonous; Growth habit; Herbaria; *Macroptilium lathyroides* (L.) Urb.; Monocotyledonous.

1. Introduction:

Flora is all the plant life present in a particular region or time, generally the naturally occurring native plants. Sudan exhibits a wide range of variation in the topography, climate, soil and hydrology. This resulted in different vegetation zones and consequently rich flora [1] also Sudan possesses many ecological zones that range from the desert and semi desert in the north to the low rainfall woodland savannah in the south.

The first descriptive flora of the plants of the Sudan was found on catalogue compiled by [2] and published in 1929. The greatest compilation of the flora of Sudan was achieved by [3,4, 5] who inventoried the flora in three volumes which now they are considered as the primary references for identification of plants species. Long time after that [6] inventoried the trees and shrubs of Sudan. After that just regional floras were carried out by many authors on different parts of Sudan; the flowering plants of Northern and Central Sudan by [7], the flora of Erkawit, Eastern Sudan by [8], the flora of central Sudan by [9] , important trees of Northern Sudan by [10], also [11] studied the flora of the area around Wadi Halfa submerged by the Aswan Dam, also the flora of Jebel Marra in Western Sudan was studied by [12]. Common weeds of Central Sudan were checked by [13]. There is a huge work done in regional flora by El [14, 15, 16, 17, and 18] who has inventoried the medicinal plants in many areas in Sudan.

Tutti Island is one of Sudan islands which located in the joint point of the White and Blue Nile in Khartoum state at N15.37 E32.29. Although Tutti Island is isolated by the three rivers (Blue Nile, White Nile and Nile rivers), the climate conditions are described as arid with low rainfall and high evaporation. Accordingly, some changes have occurred in it. Tuti Island was under sever changes due to climate change, desertification, flood disasters and human impact. From 1972 to 2018 the island witnessed several environmental changes and shifts[19]. Accordingly, this study aims to inventory and document the flora composition of the Tutti Island in order to provide reliable data that reflecting the plant composition and help in implementing planning approach to conserve the unique plant diversity in the study area.

2.Material and Methods:

2.1.The Study Area:

2.1.1.Location:

Tutti Island is situated approximately between 15^0 36\ 30″ N- 15^0 38/ 30” N and 32^0 29\ 30” E – 32^0 31\ 30” E (Figure 2) with an area of less than 8 sq. Km. Tutti is completely surrounded by water (Figure 1) as the Blue Nile flows on the Eastside and the White Nile on the South and West to the island .

2.1.2.Climate:

The climate of Tutti Island is generally arid with low rainfall and high evaporation potential [9]. The Nile shows a well-known cooling effect on the island, reducing the air temperature and increasing the relative humidity values and thus modifying the generally arid habitat. The monthly and yearly rainfall is greatly variable, however, the monthly mean maximum about (59.4 mm.) is usually reached in August while the monthly mean temperature values are relatively low $23.3C^0$ – $24.6C^0$.

2.1.3.The Soil:

Soil of Tutti Island is very fertile that because the Blue Nile dropping its yearly silty load on its banks. The soil in the island can be divided into the three types: Sandy soil, Clay soil and river mud.

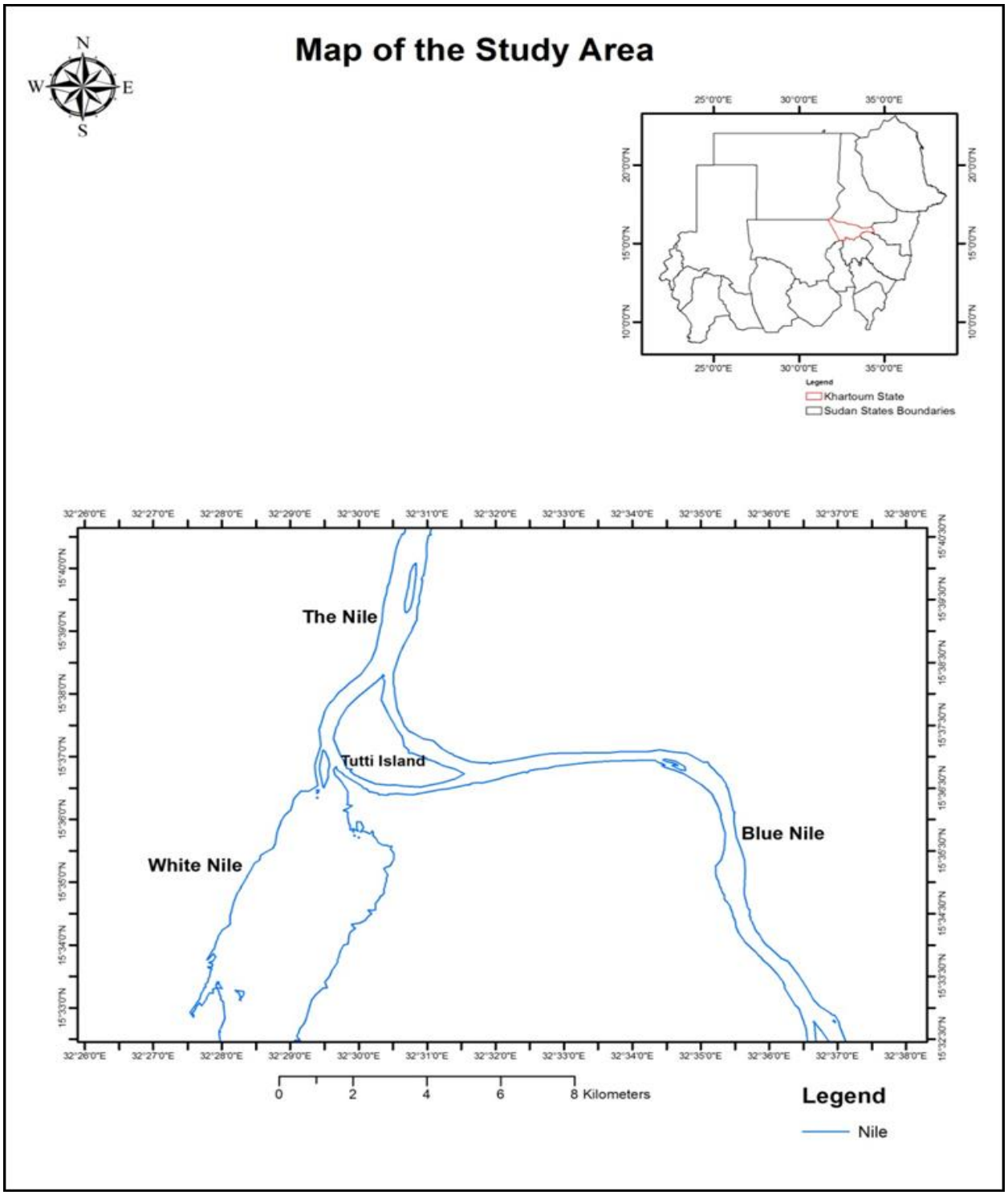

Figure 1: Map Illustrates the Location of the Tutti Island (the study area).

Figure 2: A Satellite Map Illustrates the Study Area.

2.2. Data Sampling and Analysis:

The data compilation for the Angiosperms of the Tutti Island was carried out from August 2016 to December 2018. The whole plant was collected for in case of herbs and twigs with leaves and flowers and /or fruits in case of shrubs and trees. The specimens were stretched to dry between newspapers and firmly pressed inside a herbarium press. Newspaper was continuously changed during the drying to avoid rotting of material. Subsequently, the specimens were mounted and labeled. The vouchers were checked at the Herbarium of the Medicinal and Aromatic Plants Research Institute (MAPRI), National Centre for Research (NCR) to confirm or complement its taxonomic determination. Preliminary species identification was carried out using a set of keys [3, 4, and 5] and [13]. The identified species were compared with already identified herbarium specimens in the herbarium of the (HMAPRI). The species names have been revised and updated according to the database obtained from the websites; www.theplantlist.org and https://www.ipni.org.The vernacular names of the collected species were recorded from local inhabitants within the study area and also extracted from [2] and [12].

3. Results and Discussion:

3.1. Result:

The study inventoried 155 species belonging to 120 genera and 41 families. The most representative families are: Fabaceae, Amaranthaceae, Poaceae , Malvaceae, Euphorbiaceae and Asteraceae respectively (Figure 4). Herbs represent the most representative type of growth habit followed by shrubs, vines and trees respectively (Figure 3).

Table (1): List of the plant species in the study area:

FAMILY	BOTANICAL NAME	VERNACULAR NAME.	GRWOTH HABIT
ACANTHACEAE	*Nelsonia canescens* (Lam.) Spreng.	-	Herb
	Ruellia tuberosa L.	Tataq	Herb
AIZOACEAE	*Glinus lotoides* L.	Tarba	Herb
	Trianthema portulacastrum L.	Danab el naga	Herb
	Zaleya pentandra (L.) C.Jeffrey	El rabaa'	Herb
AMARANTHACEAE	*Achyranthes aspera* L.	KashmAlnasseba	Shrub
	Aerva javanica (Burm.f.) Juss. ex Schult.	Ras Al Shayeb	Herb
	Alternanthera nodiflora R. Br.	Abu tamra	
	Alternanthera pungens Kunth.	Sim Elfar	
	Alternanthera sessilis (L.) R.Br. ex DC.	Amatera	
	Amaranthus graecizans L.	Lissan el TairSaghir	Herb
	Amaranthus spinosus L.	Lisanelteir	Herb
	Amaranthus viridis L.	Lisan el TairKabeir	Herb
	Amaranthus hybridus L.	Danab Al Kadees	Herb
	Chenopodium album L.	FissElkalib	Herb
	Chenopodium murale L.	Efain	Herb
	Digera muricata (L.) Mart.	Lablab ahmer	Herb
	Gomphrena celosioides Mart.	-	Herb
APOCYNACEAE	*Calotropis procera* (Aiton) Dryand.	Ushar	Shrub

	Leptadenia arborea (Forssk.) Schweinf.	Lewais/ Sho'bait	Vine
	Oxystelma esculentum (L. f.) Sm.	Lewis	Vine
ARECACEAE	*Phoenix dactylifera* L.	Nakheil	Tree
ARISTOIOCHIACEAE	*Aristolochia bracteolata* Lam.	Umm Glagel	Herb
ASTERACEAE	*Ageratum conyzoides* (L.) L.	RehanElguroof	Herb
	Ambrosia crithmifolia DC.	Damsissa	Herb
	Blumea viscosa (Mill.) V.M.Badillo	Rihan	Herb
	Eclipta prostrata (L.) L.	Tamr El Ghanam	Herb
	Ethulia conyzoides L. f.	Hashish El Farras	Herb
	Pluchea dioscoridis (L.) DC.	Rihan el Gadawil	Shrub
	Pulicaria crispa Sch.Bip.	Raboul	Herb
	Sonchus oleraceus L.	Moleita	Herb
	Tridax procumbens (L.) L.	-	Herb
	Xanthium strumarium subsp. *brasilicum* (Vell.) O.Bolòs& Vigo	Ramtouk	Shrub
BRASSICACEAE	*Brassica nigra* (L.) K.Koch	Khardel Aswad	Herb
	Lepidium niloticum (Delile) Sieber	El Heweira	Vine
	Rorippa indica (L.) Hiern	El zar	Herb
	Morettia philaeana DC.	Saggar	Herb
BORAGINACEAE	*Heliotropium bacciferum* Forssk.	Danab El Agrab /Rhimta	Herb
	Heliotropium indicum L.	Danab El Agrab	Herb
	Heliotropium ovalifolium Forssk.	Danab El Agrab	Herb
	Heliotropium sp.		Herb
	Heliotropium supinum L.	Danab El Agrab	Herb
	Cordia sinensis Lam.	Andorab	Tree
	Echium longifolium Delile	Shouk El Gimal	Shrub
CAPPARACEAE	*Capparis decidua* (Forssk.) Edgew.	Tundub	Shrub
	Dipterygium glaucum Decne.	Safeira	Herb

	Maerua oblongifolia (Forssk.) A.Rich.	Irg El Mahaba	Shrub
CLEOMACEAE	*Cleome gynandra* L.	Tamalaika	Herb
CONVOLVULACEAE	*Convolvulus arvensis* L.	Al ulliq	Vine
	Convolvulus microphyllus Sieber ex Spreng.	Chubeyra	Herb
	Cuscuta hyalina Roth	Hamool	Vine
	Ipomoea aquatica Forssk.	El-Arkala	Herb
	Ipomoea cairica (L.) Sweet	Sit Al Hush	Vine
	Ipomoea carnea Jacq.	El-Aweer	Shrub
CUCURBITACEAE	*Cucumis melo* L.	Hummeid	Vine
	*Cucumis prophetarum*L.	Fagos El Hameer	Vine
	Citrullus colocynthis (L.) Schrad.	Hundal	Herb
	Citrullus lanatus var. lanatus (Thunb.) Matsumura &Nakai.	BattikhAlkhala	Herb
	Coccinia grandis (L.) Voigt	IrgElDem	Vine
	Luffa cylindrica (L.) M.Roem.	Leef	Vine
	Mukia maderaspatana (L.) M.Roem.	Tbish El-Far	Vine
CYPERACEAE	*Cyperus alopecuroides* Rottb.	Seid	Herb
	Cyperus rotundus L.	Sida	Herb
	Cyperus squarrosus L.	Said	Herb
	Fimbristylis falcata (Vahl) Kunth	Dign El Tais	Herb
ELATINACEAE	*Bergia suffruticosa* (Delile) Fenzl	Rimit	Herb
EUPHORBIACEAE	*Chrozophora plicata* (Vahl) A. Juss. ex Spreng.	Al gho'bera	Shrub
	Euphorbia aegyptiaca Boiss.	Umm lebaina	Herb
	Euphorbia heterophylla L.	Um laban al Kabir	Herb
	Euphorbia hirta L	Umm lebaina	Herb
	Euphorbia indica Lam.	Malben	Herb
	Euphorbia granulata Forssk.	Libbeyn	Herb
	Phyllanthus fraternus G.L.Webster	Sorebsagir	Herb
	Ricinus communis L.	Khiruwi	Shrub
FABACEAE	*Acacia nilotica* (L.) Del.	Sunt / Garad	Tree
	Acacia seyal Del.	El taelh	Tree
	Alhagi maurorum Medik.	Al agol	Herb

	Alysicarpus monilifer (L.) DC.	Fraish	Herb
	*Clitoria ternatea*L.	Erg Elagrab	Vine
	Faidherbia albida (Del.) A.Chev.	El-Haraz	Tree
	Indigofera oblongifolia Forssk.	Dahassir	Shrub
	Indigofera tinctoria L.	Henat el groud	Shrub
	Lotus arabicus L.	Barsim El bahar	Herb
	Macroptilium lathyroides (L.) Urb.	-	Shrub
	Mimosa pigra L.	Al sit -El Mustahia	Shrub
	Parkinsonia aculeata L.	Sesaban Abu shouk	Tree
	Pithecellobium dulce (Roxb.) Benth.	Tamr Hindi	Tree
	Prosopis glandulosa Torr.	Mesquite	Shrub
	Rhynchosia minima (L.) DC.	Adan El Far	Shrub
	Senna alata (L.) Roxb.	Nawama	Shrub
	Senna.alexandrina Mill.	Senna Mekka	Shrub
	Senna. italica Mill.	Senna senna	Shrub
	Sesbania sesban (L.) Merr.	Sesaban	Shrub
	Tamarindus indica L.	Ara'daeb	Tree
	Tephrosia apollina (Delile) Link.	Amayoga	Shrub
	Trigonella spruneriana subsp. hierosolymitana (B oiss.) Ponert.	Handagoga	
	Vigna unguiculata (L.) Walp.	Lobia hello	Herb
LAMIACEAE	*Ocimum basilicum* L.	Rihan	Shrub
	Basilicum polystachyon (L.) Moench.	-	Herb
LYTHRACEAE	*Ammannia baccifera* L.	Tamar El Far	Herb
MALVAECE	*Abutilon pannosum* (G.Forst.) Schltdl.	Gargadan	Shrub
	Abutilon pannosum var. *figarianum* (Webb) Verdc.	Hambuk/ Gargadan	Shrub
	Corchorus depressus (L.) Stocks	Suteiha	Herb
	Corchorus fascicularis Lam.	Molokhia /Himaira	Herb
	Corchorus tridens L.	Molokhia	Herb
	Gossypium hirsutum L.	Gutn Arabi	Shrub
	Hibiscus trionum L	Karkauba	Herb
	Sida spinosa L.	Shadaida	Herb
	Sida ovata Forssk.	Um migasheisha	Herb
MELIACEAE	*Azadirachta indica* Adr. Juss.	Neem	Tree

MENISPERMACEAE	*Cocculus pendulus* Diels.	Zighghain	Vine
MORACEAE	*Ficus sycomorus* L.	Gameiz	Tree
NYCTAGINACEAE	*Boerhavia erecta* L.	Terba	Herb
	Boerhavia repens var.diffusa (L.)Heimerl ex JD Hooker	Terba	Herb
	Boerhavia repens L.	Shukal el kheil	Herb
ONAGRACEAE	*Ludwigia leptocarpa* (Nutt.) H.Hara	Arkala	Shrub
	Ludwigia sp.	Arkala	Shrub
OROBANCHACEAE	*Orobanche ramosa* L.	Haluk	Herb
	Striga hermonthica (Delile) Benth.	EL.Boda	Herb
OXALIDACEAE	*Oxalis corniculata* L.	Hamd	Herb
PAPAVERACEAE	*Argemone mexicana* L.	Khashkhash mexicki	Shrub
POACEAE	*Aristida adscensionis* L.	Humeira	Herb
	Brachiaria eruciformis (Sm.) Griseb.	Defera	Herb
	Cynodon dactylon (L.) Pers.	Nagil	Herb
	Dactyloctenium aegyptium (L.) Willd.	Abu Asaba	Herb
	Dichanthium annulatum (Forssk.) Stapf.	Meshra el Zaraf	Herb
	*Digitaria ciliaris (*Retz.) Koeler	Um Farow	Herb
	*Dinebra retroflexa (*Vahl) Panz.	El Mileiha	
	Echinochloa colonum (L.) Link	Defera	Herb
	Echinochloa stagnina (Retz.) P. Beauv.	Berdi	Herb
	Eragrostis ciliaris (L.) R. Br.	Danab El Asad	Herb
	*Phragmites australis (*Cav.) Trin. ex Steud	Boss	Herb
	Sorghum virgatum (Hack.) Stapf	Adaar	Herb
	Urochloa trichopus (Hochst.) Stapf	Um Furaw	Herb
	Urochloa mosambicensis (Hack.) Dandy	-	Herb
POLYGNACEAE	*Persicaria glabra* (Willd.) M.Gómez	Al-Tomsahia	Herb

PORTULACACEAE	*Portulaca oleracea* L.	Reglla	Herb
	Portulaca quadrifida L.	Lagab el Humara	Herb
RHAMNACEAE	*Ziziphus spina-christi*(L.) Desf.	Sidir	Tree
ROSACEAE	*Potentilla supine* L.	Sifairt el Bahr	Herb
SALICACEAE	*Salix mucronata* Thunb.	Safsaf	Shrub
SAPINDACEAE	*Cardiospermum halicacabum* L.	Hanbook	Vine
SOLANACEAE	*Datura innoxia* Mill.	Sakran	Shrub
	Datura stramonium L.	Sakaran	Shrub
	Physalis angulata L.	Fruta	Herb
	Solanum nigrum L.	Anab El Deeb	Herb
TAMARICACEAE	*Tamarix aphylla* (L.) H.Karst.	Tarfa	Shrub
	Tamarix nilotica (Ehrenb.) Bunge	Tarfa	Shrub
TYPHACEAE	*Typha domingensis* Pers.	Um Brim'bita	Herb
VAHLIACEAE	*Vahlia digyna* (Retz.) Kuntze	Sefairt El Bahr	Herb
VERBENACEAE	*Phyla nodiflora* (L.) Greene	Libbia	Herb
ZYGOPHYLACEAE	*Fagonia indica Burm.f.*	Um-shweeka	Herb
	Tribulus terrestris L.	El- Derissa	Herb

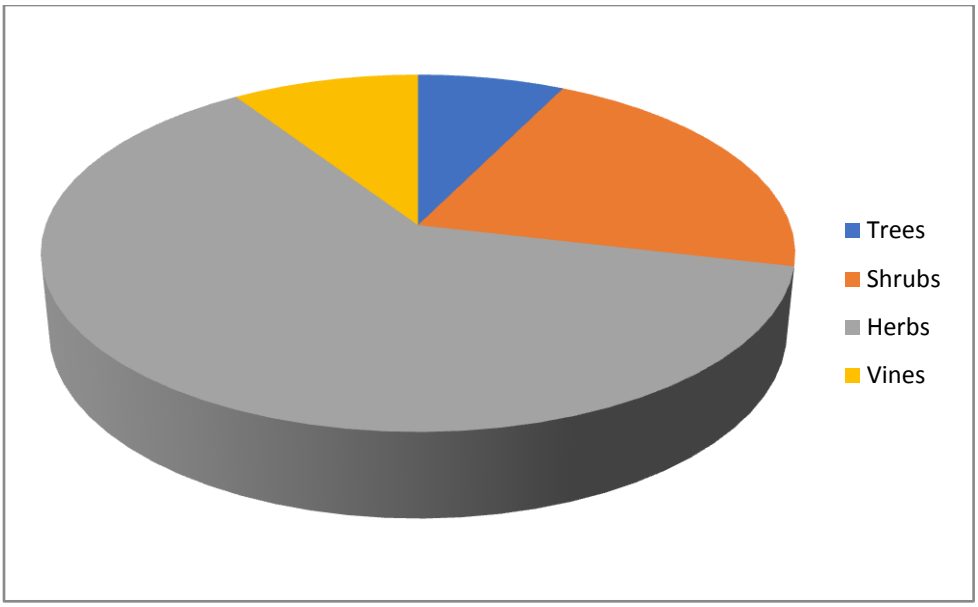

Figure 3: Chart illustrates the most representative types of growth habit of the Study area.

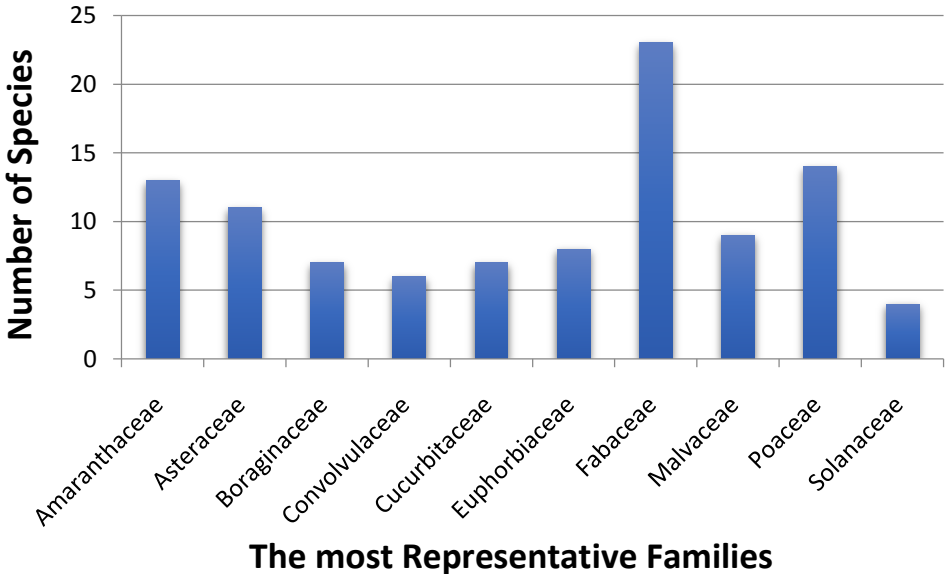

Figure 4: Chart illustrates the most representative plant families in the study area.

The study inventoried a total number of 135 species belong to Dicotyledonous which belong to 115 genus and 37 families whereas 20 species are monocotyledonous belong to 17 genus and 4 families (Table 2).

Table 2: Total number of various taxa covered in flora of the study area.

Taxa	Dicotyledonous	Monocotyledonous	Total
Families	37	4	41
Genera	115	17	132
Species	135	20	155

Also the study inventoried number of species that are not previously listed in flora of the study area (Table 3).

Table 3: List of the plant species not previously recorded in flora of the study area.

Family	**Botanical Name**	**Vernacular Name**	**Growth Habit**
Acanthaceae	*Nelsonia canescens* (Lam.) Spreng.		
Amaranthaceae	*Alternanthera nodiflora* R. Br.	Abu tamra	Herb
	A. pungens Kunth.	Sim Elfar	Herb
	Amaranthus hybridus L.	Danab Al Kadees	Small shrub
	Chenopodium album L.	Fiss Elkalib	Herb
Asteraceae	*Pluchea dioscoridis* (L.) DC.	Rihan el Gadawil	Shrub

Brassicaceae	*Coronopus niloticus* (Del.) Spreng.	El Heweira	Herb
Boraginaceae	*Cordia sinensis* Lam.	Andorab	Tree
	Echium longifolium Del.	Shouk El Gimal	Small shrub
Capparaceae	*Dipterygium glaucum* Decne.	Safeira	Small shrub
Convolvulaceae	*Ipomoea cairica* (L.) Sweet	Sit Al Husn	Vine
	I.carnea Jacq.	El-Aweer	Shrub
Cucurbitaceae	*Citrullus lanatus* (Thunb.) Matsumura & Nakai	Battikh Alkhala	Vine
	Coccinia garandis (L.) Voigt.	Fagus	Vine
	Mukia maderaspatana (L.) M.Roem.	Tbish El-Far	Vine
Euphorbiaceae	*Euphorbia granulata* Forssk.	Libbeyn	Herb
	Phyllanthus fraternus G. L. Webster	Sorebsagir	Herb
Fabaceae	*Acacia seyal* Del.	El talh	Tree
	Alysicarpus monilifer (L.) DC	Fraish	Herb
	Indigofera tinctoria L.	Henat el groud	Small shrub
	Lotus arabicus L.	Barsim El bahar	Herb
	Macroptilium lathyroides (L.) Urb.		Small shrub

	Senna alata (L.) Roxb.)	Nawama	
	Tamarindus indica L.	Ara'daeb	Tree
	Trigonella spruneriana subsp. hierosolymitana (Boiss.) Ponert.	Handagoga	Herb
	Vigna unguiculata (L.)Walp.	Lobia hello	Herb
Malvaceae	*Corchorus depressus* L.	Suteiha	Herb
Menispermaceae	*Cocculus pendulus* Diels.	Zighghain	Vine
Moraceae	*Ficus sycomorus* L.	Gameiz	Tree
Nyctaginaceae	*Boerhavia repens* L.	Shukal el kheil	Herb
	B. repens var.*diffusa* (L.)Heimerl ex JD Hooker	Terba	Herb
Onagraceae	*Ludwigia leptocarpa* (Nutt.) H.Hara	Arkala	Herb
Oxalidaceae	*Oxalis corniculata* L.	Hamd	Herb
Solanaceae	*Datura stramonium* L.	Sakaran	Small Shrub
Tamaricaceae	*Tamarix aphylla* (L.) Karst.	Tarfa	Shrub

Names of species, Genus and families constituting the flora of the study area were revised and updated according to the latest versions of the Angiosperm Phylogenic Group (APG) as shown in table (4 and 5).

Table 4: List of plant species having recent names.

Past name	Updated name
Ambrosia maritima L.	*Ambrosia crithmifolia DC.*
Blumea aurita (L.f.) DC.	*Blumea viscosa* (Mill.) V.M.Badillo
Coronopus niloticus (Del.) Spreng.	*Lepidium niloticum* (Delile) Sieber
Luffa aegyptiaca Mill.	*Luffa cylindrica* (L.) M.Roem**.**
Sida alba L.	*Sida spinosa* L.
Jussiaea aluligera Miq.	*Ludwigia leptocarpa* (Nutt.) H.Hara
Polygonum glabrum Willd.	*Persicaria glabra* (Willd.) M. Gomez
Xanthium brasilicum Vell.	*Xanthium strumarium* subsp. *brasilicum* (Vell.) O.Bolòs & Vigo

Table 5: List of plant families having recent names.

Past name	Updated name
Asclepidiaceae	Apocynaceae
Amaranthaceae(Genus:Chenopodium)	Chenopodiaceae
Caesalpiniaceae	Fabaceae
Capparaceae (Genus:Cleome)	Cleomaceae
Mimosaceae	Fabaceae
Tiliaceae	Malvaceae
Scrophularicaceae (Genus:Striga)	Orobanchaceae

The inventory of the flora of the study area led to a new generic record to the flora of Sudan; that is *Macroptilium lathyroides* (L.) Urb.

3.2. Discussion:

As the island surrounded by two rivers, Blue Nile and White Nile (Figure1), this situation provides an ideal environmental factors for species diversity. these factors are represented in: 1) Increases the relative humidity, 2) The new seeds that brought by the Nile yearly during the flood seasons, 3) The good soil-moisture content, and 4) annual renewing of the soil due to the Blue Nile dropping its yearly silty load on its banks, Consequently, the floristic list found in the study area showed a great species richness (Table 1). It worth noting that, the number of species and families inventoried in this study was greater than that previously inventoried before by [20] who had studied the flora of the Tutti island (Table 3).

However, the vegetation coverage of the study area is threatened by several human activities including overgrazing and agriculture, annual flood and increasing in population [19, 21]. These threats might affect the diversity and distribution of the plant species and even can cause disappearing of some species in the near future.

The annual flood of the Blue Nile which floods in the vast lands of the study area, definitely carriers reproductive parts (seeds, pollen grains,…etc.), accordingly, the possibility of recording or adding a new species to the flora of Sudan is certain because the Blue Nile passes through many neighboring East African countries and therefore, this study led to a new generic record to the flora of Sudan which is ***Macroptilium lathyroides*** (L.). ***M.lathyroides*** is used as a forage species in some areas. It is also a known nitrogen fixer and thus has been useful for soil amendment.

4. Conclusion:

This study has shed light on the flora composition of the Tutti Island. The study showed the richness of the island in plant composition. The study revealed that the study area is still has a satisfying plant composition, but there are several threats can affect these composition in the near future.

5. Acknowledgement:

Authors are grateful to the island people who helped in achievement of this work by providing valuable information and facilitating free movement within the

island. Also the thanks extend to Professor El Gazali for his valuable comments and helps**.**

6. Competing Interests:

Authors have declared that no competing interests exist.

7. Authors' Contributions:

MSH designed, analyzed and interpreted and prepared the manuscript.FSM designed the map and prepared the satellite image. SAAM wrote the protocol, and wrote the first draft of the manuscript. MAK interpreted and prepared the manuscript.

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