

# Current Floristic Composition and Growth Forms of Equatorial Rainforest, Kakamega County, Kenya

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**Abstract** Floristic composition and growth forms were studied in central Isecheno nature reserve part of the main tropical rainforest using transects and systematic quadrats following compass direction from January to December, 2014. Totals of 8 transect and 219 quadrats of 10m by 10m each were studied. There are 57 families represented by 124 genera composed of 146 plant species. The present composition/ inventory of plant species was recorded: Family Euphorbiaceae has maximum number of 13 species; sub-dominant families are Moraceae and Rubiaceae with 11 species each; Acanthaceae and Fabaceae families have 5 species each; Bignoniaceae family is represented by 4 species; Mimosaceae, Piperaceae, Rosaceae, Boraginaceae and Verbenaceae families represents only 3 species each; Apocynaceae, Asclepiaceae, Celastraceae, Dracaenaceae, Menispermaceae, Myrtaceae and Oleaceae families are represented only by 2 species each and 33 families are represented only by single species which reflects on poor species composition due to heavy pressure of human population to utilize resources. Five types of growth forms are present and represented by 55.48% trees, 21.94% shrubs, 8.9% herbs, 16% climbers and only 2.74% lianas. Based on the present composition/inventory of this forest, it is concluded that this equatorial forest of Kenya is under serious threat, many species have been extinct and many others are endangered.

**Keywords** Floristic composition, Growth forms, Isecheno nature reserve

## 1. Introduction

Floristic composition is the part of an inventory of any natural ecosystem composed of taxonomic and species diversity which indicates the genetic diversity of equatorial rainforest of Kakamega as a high biodiversity area with unique plants and animals [14]. Total composition or inventory states the level of degradation and also the impacts on specific species which gives us clue to plan and manage endangered and extinct species of this resources by use of biotechnological methods. Each growth forms provides suitable habitat for several plants and animal species within an ecosystem. It plays a significant role in maintaining the surrounding physical environment. Globally rainforests provide habitats for more than 5 million plant and animal species and this resource was depleted at an estimated rate of between 1-2 percent per year, since human civilization present rate of depletion has increased up to 11 percent per year. During this 21<sup>st</sup> century knowledge about the structure, composition, dynamics and taxonomy diversity of tropical rainforest has not yet been studied completely. Forest stabilize the world's climate and serves as water catchment areas, biological diversity of medicinal plants, perfumes,

home for wild animals and ancestors of many crops, source of genetic materials, fruits, resins, lignin, gums, rubber and carbon sinks. Therefore, conservation and management of forest and their diversity is the most important objective for the national and international forest management policies or laws. In the past the total area of equatorial rainforest of Kakamega was approximately 24,598 hectares but during 1967 about 13,500 hectares of indigenous equatorial rainforest was left out signifying that about 11,098 hectares is degraded due to human activities [14]. During the same period Isecheno nature reserves measuring 295 hectares and Yala nature reserves about 460 hectares were created within this tropical rainforest [4]. The main objective was to protect the rainforest area from overharvesting therefore it was divided to preserve the different forest sections of equatorial rainforest of Kakamega. However, before independence the nature reserves were affected by selective logging by local population and it was estimated that 20-30 percent of the stems had been cleared in the sub-canopy layer [8]. The previous studies of floristic composition of Kakamega tropical rainforest and its fragments presents 370 plant species [10], 213 plant species [3] and 397 species of plants comprising of 112 trees species, 62 shrub species, 58 climber species, 141 herbs species and 24 ferns species [2]. Change in floristic composition is a key challenge for ecologists, bio-geographers and resource managers [6, 15]. Therefore, for effective conservation of any ecosystem is important to understand its past and current floristic composition.

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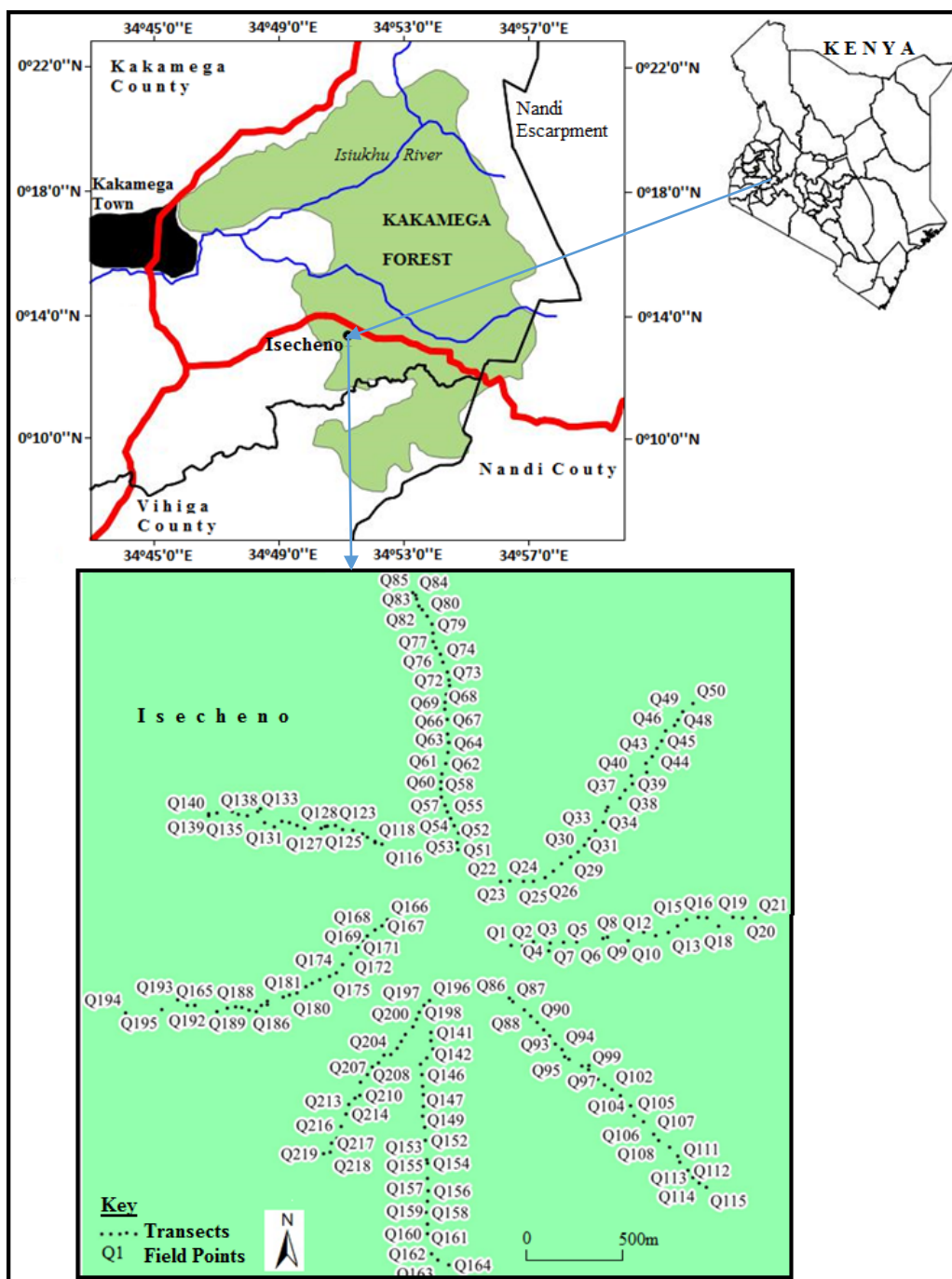
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## 2. Material and Methods

### 2.1. Description of Study Area

Floristic composition which was studied in central Isecheno nature reserve covers about 295 hectares part of equatorial/tropical rainforest located at Latitudes 0° 19' N and Longitudes 34° 52' E; between 1574-1623 metres above the sea level in Kakamega County at the distance of 425 km North-West from the capital city Nairobi, (Kenya) (Figure 1).

It is separated by highlands of Cherangani's in the North and the Mau Escarpment in the South. To the East, Kakamega forest borders the North-Nandi forest which is found on an escarpment which stretches in North-South orientation. This rainforest covers approximately 241 km<sup>2</sup>, including about 135 km<sup>2</sup> of indigenous forest and 57 km<sup>2</sup> of plantations [10]. The area is characterized by hot and wet climate with mean annual temperature of about 25°C and its rainfall is between 1500-2000mm with a dry season from December to March.



**Figure 1.** Map of the Study area showing locations and distribution of Eight transects and 219 quadrats used to collect plant species within Isecheno section of rainforest of Kakamega, Kenya

## 2.2. Data Collection and Analysis

An extensive vegetation survey was carried out during the study period using systematic sampling according to [9, 13] to study floristic composition by use of transects and quadrats methods. Sampling quadrats were arranged along eight transect, each starting from the peripheral of the Kalunya glade in the core of the forest following the compass direction of (E, NE, N, NE, N, NW, W, SW, S, SE) to the edge of forest adjacent to the tea plantation (Figure 1). the starting point and the end point of each transect line and each quadrat site were recorded using a GPS and it was visualized in Arc view 3.X to allow way points to be relocated in the future. Each of the eight transects contain different number of 10m by 10m (100m<sup>2</sup>) quadrats. The first quadrat was placed at 5m from the edge of the glade and more quadrats were laid down along the line of transects at an interval of 50m from each other so that maximum variations could be recorded. Species occurring within 10m radius from the quadrats boundaries were also recorded for floristic composition. In total 219 quadrats were studied for sampling. All angiospermae plants available in the study area were identified in the field, each specimen collected, pressed, dried and mounted on standard sheets for further identification. The plant species that could not be identified in the field, their specimen were taken to the herbarium section of the national museum of Kenya for identification using previous collection. The growth forms of all vascular plants were identified, determined and classified according to [1, 3, 5, 11, 12]. A complete checklist of angiospermae plant species representing trees, shrubs, herbs, climbers and lianas was made systematically selected quadrats along each transect.

## 3. Results and Discussions

### 3.1. Floristic Composition

The total number of 146 plant species belonging to 124 genera and 57 families were identified in the study area. The families with respect to number of species in the study area

were Euphorbiaceae family represented by 13 species; Moraceae and Rubiaceae with 11 species each; Acanthaceae and Fabaceae with 7 species each; Rutaceae has 6 species; Sapotaceae, Flacourticeae, Meliaceae, Sapindaceae and Ulmaceae has 5 species each; Bignoniaceae is represented by 4 species; Mimosaceae, Piperaceae, Rosaceae, Boraginaceae and Verbenaceae represents only 3 species each; Apocynaceae, Asclepediaceae, Celastraceae, Dracaenaceae, Menispermaceae, Myrtaceae and Oleaceae are represented by 2 species each whereas 33 families namely Adiantaceae, Alangiaceae, Anacardiaceae, Annonaceae, Araliaceae, Balsaminaceae, Basellaceae, Caparaceae, Commelineaceae, Cucurbitaceae, Dennistaedtiaceae, Dryopteridaceae, Ebenaceae, Gutiferae, melianthaceae, Musaceae, Myrsinaceae, Nyctaginaceae, Olacaceae, Orchidaceae, Poaceae, Passifloraceae, pittosporaceae, Plantaginaceae, Rhamnaceae, Rhizophoraceae, Solanaceae, Sterculiaceae, Theaceae, Urticaceae, Vitaceae and Zingiberaceae have only 1 species. It is noticed that 54% of the families are represented by only one species each, it shows that floristic composition is poor due to human activities. Species richness per family supports forest ecosystem against severe depletion in case of degradation. Loss of such plant species not only implies the native extinction of the family and its genera but also complete interference with forest ecosystem parallel and cyclic configuration processes undertaken by such plant species. The high representation of Euphorbiaceae family mostly found in marginal areas is an indication that Kakamega forest is highly disturbed. [7, 14] documented similar floristic composition. (Table 1 & Figure 2).

### 3.2. Growth Forms

Based on the height, growth and nature of plant species only five growth forms are present in Isecheno nature reserve; (i) 81 trees (ii) 32 shrubs (iii) 13 herbs (iv) 16 climbers and (v) 4 lianas. (Figure 3). It is noticed that there are 55.48% trees, 21.92% shrubs, 8.9 % herbs, 16% climbers and only 2.74% lianas.

**Table 1.** Floristic Composition and Growth Forms within Isecheno Nature reserve of Kakamega forest, Kenya

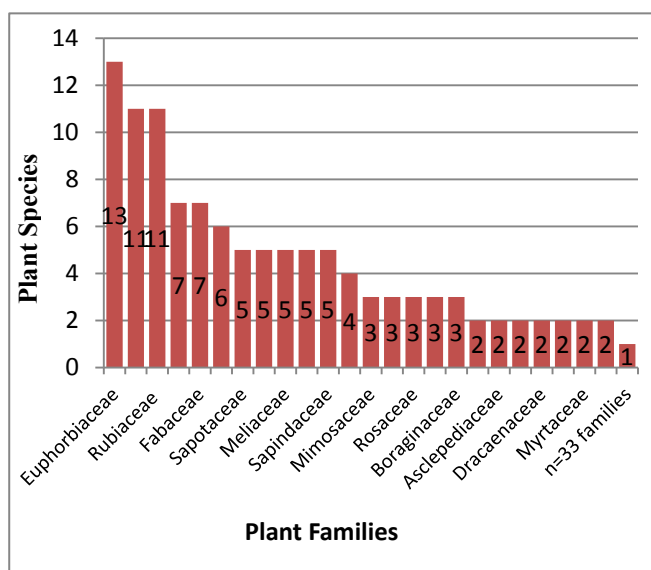
Number of families		Plant species	Growth forms (T=trees, S=shrubs, C=climber, H=herbs, L=lianas)
1	Acanthaceae	1. <i>Acanthus pubescens</i> (Oliv.) Engl.	S
		2. <i>Brillantaisia madagascariensis</i> Li ndau	H
		3. <i>Hypoestes aristata</i> (Vahl) Sol. Ex Roem. & Schult	H
		4. <i>Justicia extensa</i> T. Anderson	C
		5. <i>Justicia flava</i> (Forssk.) Vahl.	C
		6. <i>Mimulopsis arborescens</i> C. B. Clarke.	S
		7. <i>Mimulopsis solmsii</i> Schweinf.	S
2	Adiantaceae	8. <i>Doryopteris concolor</i> Langsd. & Fisch	H
3	Alangiaceae	9. <i>Alangium chinense</i> (Lour.) Harms	T
4	Anacardiaceae	10. <i>Sclerocarya birrea</i> (A.Rich.) Hochst.	T
5	Annonaceae	11. <i>Monodora myristica</i> (Gaertn.) Dun.	T

Number of families		Plant species	Growth forms (T=trees, S=shrubs, C=climber, H=herbs, L=lianas)
6	Apocynaceae	12. <i>Funtumia africana</i> (Benth.) Stapf	T
		13. <i>Tebernaemontane ventricosa</i> A. DC.	T
7	Araceae	14. <i>Culcasia falcifolia</i> Engl.	L
8	Araliaceae	15. <i>Polyscias fulva</i> (Hiern.) Harms	C
9	Asclepiaceae	16. <i>Mondia whitei</i> (Hook. f.) Skeels	H
		17. <i>Periploca linearifolia</i> Dill & Rich.	C
10	Balsaminaceae	18. <i>Impatiens burtonii</i> Hook.f.	H
11	Basellaceae	19. <i>Basella alba</i> L.	C
12	Bignoniaceae	20. <i>Kigelia africana</i> (Lam.) Benth.	T
		21. <i>Kigelia moosa</i> (Sprague.) Bidgood & Verde	T
		22. <i>Markhamia lutea</i> (Benth.) K. S chuman	T
		23. <i>Spathodea campanulata</i> (Seem.) Bidgood	T
13	Boraginaceae	24. <i>Cordia africana</i> Lam.	T
		25. <i>Cordia milenii</i> Baker	T
		26. <i>Ehretia cymosa</i> Thonn.	T
14	Capparaceae	27. <i>Ritchiea albersii</i> Gilg	S
15	Celastraceae	28. <i>Hippocratea africana</i> (Willd.) Loes.	L
		29. <i>Maytenus heterophylla</i> (Eckl. & Zeyh.) N. Robson	S
16	Commelinaceae	30. <i>Aneilema beniniense</i> (P.Beauv.) Kunth	C
17	Cucurbitaceae	31. <i>Momordica foetida</i> Schumach	C
18	Dennstaedtiaceae	32. <i>Pteridium aquilinum</i> L	H
19	Dracaenaceae	33. <i>Dracaena fragrans</i> L.	S
		34. <i>Dracaena laxissima</i> Engl.	S
20	Dryopteridaceae	35. <i>Dryopteris athamatica</i> (Kunze) Kuntze	H
21	Ebenaceae	36. <i>Diospyros abyssinica</i> (Hiern) White	T
22	Euphorbiaceae	37. <i>Acalypha fruticosa</i> Forssk.	S
		38. <i>Alchornea laxiflora</i> (Benth.) Pax & K.Hoffm.	S
		39. <i>Bischofia javanica</i> Bl.	T
		40. <i>Bridelia micrantha</i> (Hochst.) Baill.	T
		41. <i>Croton macrostachyus</i> Del.	T
		42. <i>Croton megalocarpus</i> Hutch.	T
		43. <i>Croton sylvaticus</i> Hochst.	T
		44. <i>Erythrococca atrovirens</i> (Pax) Prain	S
		45. <i>Erythrococca trichogyne</i> (Muell. Arg.) Prain	S
		46. <i>Macaranga kilimandscharica</i> Pax	T
		47. <i>Margaritaria discoidea</i> (Baill.) Webster	T
		48. <i>Phyllanthus fischeri</i> Pax	S
		49. <i>Sapium ellipticum</i> (Krauss) Pax	T
23	Fabaceae	50. <i>Acacia brevispica</i> (Benth.) Brenan	T
		51. <i>Acrocarpus fraxinifolius</i> J.P.M Brenan	T
		52. <i>Craibia brownie</i> Dunn	T
		53. <i>Dalbergia lactea</i> Vatke	S
		54. <i>Desmodium repantum</i> (Vahl) DC.	H
		55. <i>Erythrina abyssinica</i> DC.	T
		56. <i>Senna spectabilis</i> DC	T
24	Flacourtiaceae	57. <i>Casaeria battiscombei</i> R. E. Fries	T
		58. <i>Dovyalis abyssinica</i> (A.Rich.) Warb	T
		59. <i>Dovyalis macrocalyx</i> (Oliv.) Warb.	S
		60. <i>Rawsonia lucida</i> Harv. & Sond	S
		61. <i>Oncoba routledgei</i> (Sprague.) Forss	T
25	Guttiferae	62. <i>Harungana madagascariensis</i> Lam. Ex Poir.	T
26	Meliaceae	63. <i>Khaya anthotheca</i> (Welw.) C. DC.	T
		64. <i>Lepidotrichilia volkensii</i> (Guerke )Lerroy	T
		65. <i>Trichilia emetica</i> Vahl	T

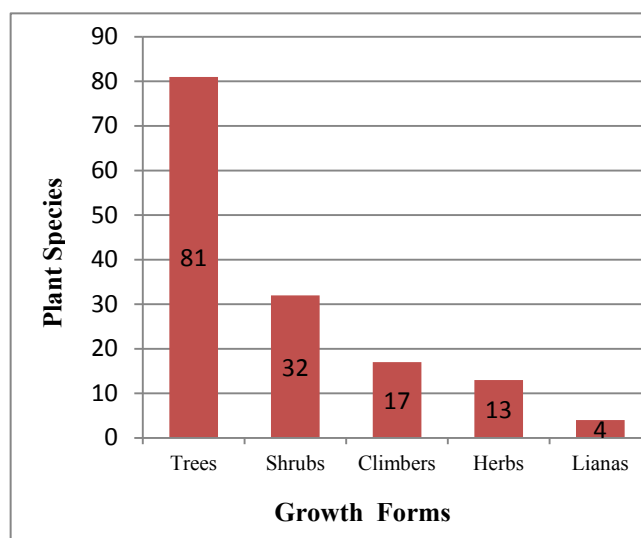
Number of families		Plant species	Growth forms (T=trees, S=shrubs, C=climber, H=herbs, L=lianas)
		66. <i>Toona ciliata</i> M.Roem	T
		67. <i>Turraea holstii</i> Guerke	T
27	Melanthaceae	68. <i>Bersama abyssinica</i> Fres.	S
28	Menispermaceae	69. <i>Stephania abyssinica</i> (Dillon & A.Rich.) Walp.	L
		70. <i>Tiliacora funifera</i> (Miers) Oliv.	L
29	Mimosaceae	71. <i>Albizia gummifera</i> (J.F. Gmel) C. A.Sm.	T
		72. <i>Albizia grandibracteata</i> Taub.	T
		73. <i>Entada abyssinica</i> Steud. Ex A. Rich	T
30	Moraceae	74. <i>Antiaris toxicaria</i> (Pers.) Lesch.	T
		75. <i>Ficus asperifolia</i> Miq.	T
		76. <i>Ficus bubu</i> Warb.	T
		77. <i>Ficus exasperata</i> Vahl.	T
		78. <i>Ficus lutea</i> Vahl.	T
		79. <i>Ficus natalensis</i> Hochst.	T
		80. <i>Ficus sur</i> Forssk.	T
		81. <i>Ficus thonningii</i> Bl.	T
		82. <i>Milicia excelsa</i> (Welw.) C.C Berg	T
		83. <i>Morus mesozygia</i> Stapf.	T
		84. <i>Trilepisium madagascariense</i> DC.	T
31	Musaceae	85. <i>Ensete ventricosum</i> (J.F.Gmel.) Horan	T
32	Myrsinaceae	86. <i>Maesa lanceolata</i> Forssk.	T
33	Myrtaceae	87. <i>Psidium guajava</i> L.	T
		88. <i>Syzygium cumini</i> (L.)	T
34	Nyctaginaceae	89. <i>Pisonia aculeata</i> L.	C
35	Olacaceae	90. <i>Strombosia scheffleri</i> Engl.	T
36	Oleaceae	91. <i>Chionanthus mildbraedii</i> (Gilg & Schellenb)	T
		92. <i>Olea capensis</i> L	T
37	Orchidaceae	93. <i>Aerangis kotschyana</i> (Rchb.f.) Schltr	H
38	Passifloraceae	94. <i>Adenia cissampeloides</i> (Benth.) Harms	C
39	Piperaceae	95. <i>Piper capense</i> L.	H
		96. <i>Piper guineense</i> Schumach. & Thonn.	C
		97. <i>Piper umbellatum</i> L.	S
40	Pittosporaceae	98. <i>Pittosporum manii</i> (S.l.)	T
41	Plantaginaceae	99. <i>Plantago palmata</i> Hook. F.	H
42	Poaceae	100. <i>Leptaspis coculeata</i> Thwaites	H
43	Rhamnaceae	101. <i>Maesopsis eminii</i> Engl.	T
44	Rhizophoraceae	102. <i>Cassipourea ruwensorensis</i> (Engl.) Alston	T
45	Rosaceae	103. <i>Eriobotrya japonica</i> Lindl	T
		104. <i>Prunus Africana</i> (Hook. f.) Kalkm.	T
		105. <i>Rubus keniensis</i> Standl.	S
46	Rubiaceae	106. <i>Coffea eugenioides</i> S. Moore	S
		107. <i>Heinsenia diervilleoides</i> K. Schum.	T
		108. <i>Keetia gueinzii</i> (Sond.) Bridson	C
		109. <i>Leptactina platyphylla</i> (Hiern) Wernh	S
		110. <i>Oxyanthus speciosus</i> DC	S
		111. <i>Pavetta oliveriana</i> Hiern	C
		112. <i>Psychotria peduncularis</i> (Salisb.) Steyerf.	S
		113. <i>Rothmannia urcelliformis</i> (Hiern) Robyns	S
		114. <i>Rutidea orientalis</i> (Sond.) Bridson	C
		115. <i>Tarenna pavettoides</i> (Harv.) Sim.	S
		116. <i>Vangueria apiculata</i> K. Schum.	S
47	Rutaceae	117. <i>Clausena anisate</i> (Willd.) Benth.	S
		118. <i>Fagaropsis angolensis</i> (Engl.) Dale	T
		119. <i>Teclea nobilis</i> Del.	T

Number of families		Plant species	Growth forms (T=trees, S=shrubs, C=climber, H=herbs, L=lianas)
48	Sapindaceae	120. <i>Toddalia asiatica</i> (L.) Lam.	C
		121. <i>Zanthoxylum chalybeum</i> . Engl.	T
		122. <i>Zanthoxylum gillettii</i> (De Wild.) Waterm	T
		123. <i>Allophylus abyssinicus</i> (Hochst.) Radlk.	S
		124. <i>Allophylus africanus</i> P. Beauv.	T
		125. <i>Blighia unijugata</i> Bak.	T
		126. <i>Deinbollia kilimandscharica</i> Taub.	T
49	Sapotaceae	127. <i>Paullinia pinnata</i> L.	C
		128. <i>Aningeria altissima</i> (A. Chév.) Aubrév. & Pellegr.	T
		129. <i>Bequaertiodendron oblanceolatum</i> (S. Moore)	T
		130. <i>Chrysophyllum albidum</i> G. Don	T
		131. <i>Chrysophyllum viridifolium</i> Wood & Franks	T
		132. <i>Manilkara butugi</i> Chiov.	T
50	Solanaceae	133. <i>Solanum mauritianum</i> Scop.	S
51	Sterculiaceae	134. <i>Dombeya burgessiae</i> Gerrard	T
52	Theaceae	135. <i>Camellia sinensis</i> (L) Kuntze	S
53	Ulmaceae	136. <i>Celtis africana</i> Burm. F.	T
		137. <i>Celtis durandii</i> Engl.	T
		138. <i>Celtis mildbraedii</i> Engl.	T
		139. <i>Chaetacme aristata</i> Planch	S
		140. <i>Trema orientalis</i> L.	T
54	Urticaceae	141. <i>Urera trinervis</i> (Hochst.)	C
55	Verbenaceae	142. <i>Clerodendrum johnstonii</i> Oliv.	C
		143. <i>Premna angolensis</i> Guerke	T
		144. <i>Vitex keniensis</i> Turill	T
56	Vitaceae	145. <i>Leea guineense</i> G. Don.	S
57	Zingiberaceae	146. <i>Afromomum africana</i> K. Schum.	H

Key: -T(tree) > 5 meters, S(shrub) 1-5 meters, H(herb) < 1 meter, C(climber) <5 meters and L (lianas) >20 meters.



**Figure 2.** Bar diagram shows plant families comprising the number the number of species in the rain forest of Kenya (Jan-Dec 2014)



**Figure 3.** Bar diagram shows growth forms of plant species studied within Isecheno section of rainforest situated in western part of Kenya

## 4. Conclusions and Recommendations

The present study represents the first comprehensive floristic composition and growth forms of Isecheno nature reserve part of the main tropical rainforest of Kakamega. In this forest with economically and ecologically important plants, there are 57 families, 124 genus and 146 plant species. At the moment 57.89% families are represented by only one genus that indicates significant loss of taxonomic and genetic diversity due to selective harvesting of specific plant species by human population accessing this nature reserve. The study also reveals five types of growth forms made up of 81 trees, 32 shrubs, 13 herbs, 16 climbers and 4 lianas. The edge of the forest which is easily accessible by local population is planted by tea and sugar cane. This is disrupting floristic composition in Isecheno nature reserve dominated by members of Euphorbiaceae family which normally grow in marginal areas.

This inventory of floristic composition and growth forms is vital as a baseline to evaluate trends of each species and in follow up studies to determine change particularly after mitigation measures have been put in place. Therefore, it is important to keep updated records of floristic composition so that the inventory will reflect on each species to provide proper attention to measure impacts, plan, conserve and sustainable management depending on the species frequency, dominance, endangered and extinct species to improve protection within the nature reserve using bio-technological methods.

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