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Competitive Biodiversity of Human and Vascular Plant Species: The Implications for Pharmaceutical Industries, Health and World Economy Part- 2

Saganuwan Alhaji Saganuwan[1*]

[1]*Department of Veterinary Physiology, Pharmacology and Biochemistry, College of Veterinary Medicine, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria.*

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aims: The world population is increasing at alarming rate vis-à-vis the need for health and many vascular medicinal plants are being destroyed. So we risk upsetting the ecological balance of the earth.
Methodology: To avoid ecological health disaster, literature survey of human, vascular plants and vascular medicinal plants populations was carried out with a view to determining their relationship with health and economic development.
Results: A total of 210 countries and Islands with human population (7,423,552,000), area (133,484,423.4 km^2) and population density (55.61 per km^2) were recorded. The survey of vascular plant species revealed 1,855,563 higher plants, 157,346 medicinal plants and 154,308 endemic plants in 115 countries respectively. Columbia has the highest number of plant species (50,000) in the world. Whereas China has the highest number of human (1,339,190,000) and discovered medicinal plants (11,146). Asteraceae has the largest number of vascular plant species (25,000).
Conclusion: The estimated higher number of vascular plant species, medicinal plants and endemic plants may be due to further discovery, synonym in their names, similarity in their morphology and repeated countings. The increased world population and over exploitation of medicinal plants may pose risk of rarity, extinct, and endanger to some plants with high therapeutic potentials.

**Corresponding author: E-mail: pharn_saga2006@yahoo.com;*

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1. INTRODUCTION

Estimation of total number of vascular plants has been a hectic research for botanists needless to say of the estimation of vascular plant species whose medicinal values have been either claimed or established. The notable researchers in the field are [1–5]. Because of very high pressure on the use of vascular plant species, deforestation, environmental degradation, urbanization, climate change and thorough search by pharmaceutical industries for medicinal plants, there is need for survey of all the vascular plant species whose medicinal values have been claimed or established across the globe with a view to determining its implications on pharmaceutical industries, health and world economy.

2. METHODOLOGY

Past and recent textbooks, journals, books of abstract and proceedings, other periodicals and data bases were consulted for information on plant census, country name, human population, country area, human population density, plant population, medicinal plant population and plant endemism per country. Whereas the estimated number of plant species per country was based on the reports from various literatures. Medicinal plant species of the different countries were either estimated by previous authors or extrapolated from the data of medicinal plants estimated in nearby countries or countries from the same ecological environment. Since some countries share similar ecological habitat in terms of human and plant population. For example, Brazil and Colombia are neighbouring countries each with large population of medicinal plants. Also, China and India are also neighbouring countires with very large human populations. Based on principle of "treat yourself with medicines of your land; estimation of medicinal plants was also based on population of countries in which they are found. Because some countries also share similar ecological habitats, estimation was also based in similarity in plants ecology. After the estimation, human and plant populations, human population density, total number of vascular plant species, medicinal plants and plants endermic to some countries were calculated arithmetically and presented in tabular forms.

3. RESULTS

The total number of some vascular plant species as reported from various literatures are presented in Tables 1-6. A total of 7,423,552,000 human population has been estimated for 210 countries and islands with 133,484,423.4 km^2 of land and total population density of 55.61 per km^2. But 188 countries, recorded a total of 1,880,563 species of vascular plants with 157346 from 154 countries having medicinal values. However, a total of 154,308 vascular plant species is endemic in 115 countries. The leading families with high number of plant species are Asteraceae (25,000), Orchidaceae (20,000) and Fabaceae (18,000). The countries of endemism include but not limited to India, Nigeria, Egypt, Turkey, Peru, Congo DR, Uganda, Sri Lanka, Tunisia, Libya and Oman. Literatures search has shown Columbia to have highest number of higher plants (50,000) followed by China (32,000), Mexico (30,489), Indonesia (30,000), Turkey (28,889), Peru (25,000), USA (21,641), and Madagascar (16,000) respectively. More so China seems to have highest number of discovered medicinal plants (11,145), followed by Turkey (10,000), Indonesia (7,000), Mexico (5,000), Vietnam (3,300), United States (2,561), Madagascar (3,265), Malaysia (2,000), Nigeria (2,000) and Thailand (1,800).

4. DISCUSSION

The estimated value of 1,880,563 inventoried plant species from 188 countries (Tables 1-6) disagrees with the report of [2,4,5] indicating that on the earth planet, there are 422,127, 352,000 and 310,000 – 320,000 flowering plants respectively. The plant working list of all known vascular plant species version 1 contains 1,244,871 scientific plant names of which 298,900 are accepted species names [6]. In 2001, Govaerts estimated 422,127 vascular plant species based on estimated 1,015,000 reported in Index Kewensis [1]. The estimated 1,880,563 vascular plants in the present survey may suggest, a large number of vascular plant species are yet to be enumerated, despite the fact that synonym in names, similarity in species and repetitive counts must have contributed to the estimated high number of the vascular plant species. But estimated 157,346 number of medicinal plants may suggest increased discovery of plants with medicinal values, despite

the fact that we cannot rule out the possibility of numerous counting for species of a plant. Our findings of 154,308 vascular plant species that are endemic to 115 countries suggest that many more plants that are endemic to many countries are increasingly being discovered, despite the fact that some others plants are being threatened. The increasingly discovered medicinal plants may not be able to serve a world population of over 7 billion that may likely depend on the vascular plants for food, medicine, shelter and protection. Although over 400,000 vascular plant species have been classified. Most biologists believe that the evolution of this kingdom protista gave rise to two lines: the nonvascular plants like the mosses evolved as one type of plant and the vascular plants like the ferns evolved as a second type. Some of the vascular types evolved into seed producing plants [7].

4.1 Asia

The estimated vascular plant species and medicinal plants are given in Table 1. Global estimates indicate that 80% of about 4 billion population rely on traditional medicine in India, Sri Lanka and South-East Asia which has more than 80,000 plant remedies and using around 35,000 – 70,000 plant species. South-East Asia alone using 61,950 medicinal plants.

Out of 143,000 vascular plant species found in Asia, about 77,750 plant species are endemic in Asia [48]. It has been reported that natural products (their derivatives and analogs) represent over 50% of all drugs in clinical use, in which natural products derived from higher plants represent about 25% of the total. Saganuwan reported a total of 153 medicinal plants of Arabian Pennisula indicating the increased use of the plants by Asians [49]. About 4000 out of 6000 plant species grow in mountainous regions of one of the four provinces of Pakistan i.e. North West Frontier province and northern region of Hindukush-Himalayas [50]. The total number of estimated species in Kurama Agency are 1200 [51]. But about 70% of the total species are uni-regional and the remaining 30% are either bi-or-pluri-regional. More than 60% of Pakistan population who live in rural areas use traditional medicine [52]. Pakistan possesses high mountains such as Hindu kush, Himalayas and Karakurum, the snow averred peaks, eternal glaciers, the high lying cold deserts, the vast irrigated plants, the bleak hot low lying than those deserts, the rocky plateaus in Sind and Baluchistan and the coastal shores provide all the possible habitats for development of plant communities. However, the salt large basin begins in the east of thelum in the Tilla Jogian and runs south west to cross the River Indus near Kala Bgoh. On the west of river Indus, the Salt Range continues South wards to the districts of Bannu and D. I. Khan. Geographically, the salt range lies between 32° 23' – 33° 00 and 71° 30' – 73° 30' in the northwest of Punjab province [11,25]. Salinity is an important problem in more than one third of the world's agricultural lands and it causes yield decrease in many crops [50]. It is well known that salinity tolerance should be taken into consideration, because if plants are sensitive to their late growing periods, they are most probably sensitive to salt in their seedling periods [29]. About 7% of arable lands of the world are under salinity pressure [30]. High levels of soil salinity negatively affect productivity of most field crops. Saline soils remarkably reduce oil production potential and oil yield of sunflower. Acid soils occupy nearly 40% of farmland in the world. They are mainly distributed in the tropical and subtropical area. It was estimated in 1995 that about 2.3 billion people (41% of the world's population at that time) resided in river basins considered to be water stressed and this value was predicted to increase to 3.5 billion by 2025 (48% of the expected world population) [25].

India is one of the world's 12 biodiversity centres blessed with two (Eastern Himalayas) of the eighteen worlds' hots pots of plant biodiversity and is seventh among the sixteen-mega diverse countries. India was said to have over 17,500 species of higher plants, 64 gymnosperms, 1,200 Pteridophytes, 2,850 bryophytes, 2,021 lichens, 15,500 fungi and 6,500 algae are reported. India is rich in its own flora with endemic plant species (5,725 angiosperms, 10 gymnosperms, 193 Pteridophytes, 678 bryophytes, 466 liverworts, 466 lichens, 3,500 fungi and 1,924 algae) [53]. India's biodiversity is unmatched due to the presence of 16 different agro-climatic zones, 10 vegetation zones, 25 biotic provinces, and 426 biomes (habitats of specific species). Only 7,000-7,500 species are used for their medicinal values by traditional communities. The Ayurveda system of medicine uses about 700 species, Unani 700, siddha 600, Amchi 600 and modern medicine around 30 species [21]. Asian continent is not the only most populated among all the continents in terms of human and plant populations [9] but also may be

Table 1. Distribution of human and vascular plant species in Asia

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
China*	1,339,190,000	9,596,960	139.54	32,645	11,250	17,300
India*	1,184,639,000	3,287,590	360.34	18,664	7,500	5,150
Indonesia*	234,181,400	1,919,440	122.01	30,000	7,000	15,000
Pakistan	170,260,000	803,940	211.78	6,000	2,000	400
Bangladesh	164,425,000	144,000	1,141.84	5,000	≥ 1,000	16
Bahrain	807,000	691	1,167.87	248	62	-
United Arab Emirate	2,5000,000	83,600	29.90	600	-	-
Palestine	2,300,000	6,065	379.23	2,600	700	
Iran	75,078,000	1,648,000	45.56	14,000	8,000	-
Kuwait	3,051,000	17,820	171.21	282	70	-
Philippines	94,013,200	300,000	313.38	13,500	≥ 1,500	3,500
Vietnam	85,789,573	330,000	259.97	12,000	≥ 3,300	4,800
Turkey*	72,561,312	780,580	92.96	9,500	≥ 500	3,000
Eritrea	5,224,000	121,320	43.06	522	142	-
Thailand	63,525,062	514,000	123.59	12,000	2,000	1,400
Comoros	691,000	2,230	318.43	721	-	136
Russia	141,927,297	17,075,200	8.31	11,400	1,103	2,280
Mayanmar	50,496,000	678,500	74.42	14,000	-	1,071
Kazakhstan	17,000,000	2,724,900	6.24	6,000	-	533
Brunei	407,000	5,770	70.54	6,000	-	-
Japan	127,280	377,835	337.13	5,565	1,469	-
Afghanistan	28,000,000	647,500	43.24	4,500	215	-
South Korea	49,773,145	98,480	505.41	3,400	2,000	224
Nepal	29,853,000	140,800	212.02	7,000	1,463	246
Malaysia*	28,306,700	329,750	85.94	15,500	2000	-
Syria	22,505,000	185,180	121.53	3,459	395	-
Srilanka	20,743,000	65,610	316.16	≥3,700	1,414	1,036
Mauritius	1,297,000	2,040	635.78	750	-	325
Tajikistan	7,075,000	143,100	49.44	5,000	>450	640
Iraq	24,700,000	437,072	56.51	3,000	1,500	190
Korea (North)	23,991,000	120,540	199.03	4,200	260	
Maldives	314,000	90,000	3.49	500	300	70
Borneo	-	-	-	25,000	-	-
Tunisia	10,432,500	163,610	63.76	2,196	597	151
Israel	7,602,400	27,800	273.46	2,225	152	165
Jordan	6,472,000	92,300	70.12	2,100	485	145
Laos DR	6,436,000	236,800	27.18	8,286	1,400	-
United Arab Emirates	4,707,000	82,880	56.79	600	150	-
Lebanon	4,255,000	10,452	409.13	2,800	700	311
Oman	2,905,000	212,460	13.67	1,200	275	223
Mongolia	2,766,800	1,566,500	1.77	≥ 3,000	1,430	-
Singapore	4,987,600	693	7,197.11	-	-	-
Bhutan	2,163,000	47,000	46.02	5,468	200	-
Qatar	1,696,563	11,437	148.34	306	77	-
Saudi Arabia	26,246,000	1,960,582	13.39	2,028	464	34
Seychelles	85,000	455	186.81	250	-	182
Turkmenistan	5,177,000	488,100	10.61	3,140	442	225
Uzbekistan	27,794,000	447,400	62.12	>4,000	-	900
Yemen	24,256,000	527,970	45.94	>3,000	648	300
Bhutan	2,094,176	47,000	44.56	5,600	600	
Taiwan	22,000,000	35,980	611.45	4,000	1,500	-
Kyrgyzstan	5,550,000	198,500	27.96	4,500	200	-
Iraq	31,467,000	437,072	72.00	3,000	750	190
Aruba & Curacao	243,680	637	382.54	460	172	23
Saint Martin	29,400	53.2	552.63	446	167	1

*- = unknown; information from references 8 – 47,206, * = highly populated*

assumed to be the continent where Adam and Eve lived on before their generations got dispersed. It is the continent where Noah's ark landed after flood (tufan) destroyed his unbelievers. The place is referred by holy Quran as Judy which is taken to be the present Jordan. In India, nearly 9,500 registered herbal industries and a multitude of unregistered cottage-level herbal units depend upon the continuous supply of medicinal plants for manufacturing of herbal formulations. But about 70% of the country's population use plants for health care. A list of 960 medicinal plants taxa in India has been well-researched and a priority list of 176 medicinal plant species in high trade i.e. Species with annual trade of > 100MT has attracted attention for management conservation. The annual demand of botanical raw drugs in India has been estimated at 3,019,500 MT for the year 2005-2006. Estimated annual demand of botanical raw drugs by herbal industry, rural households and exports in India are 1,077,000, 86,000 and 56,500 respectively [54]. In India, Amla (Emblica officinalis) is the highest consumed botanical raw by the domestic herbal industry and exports of Isabgol (Psyllium husk), Senna (leaves and pods), Henna (leaves and powder) and Myrobalans account for nearly 70% of total exports of plant raw drugs. From 2004 to 2005 a total of 37,483 MT was imported and the import of Gum Arabic and *Pipper longum* constituted more than 58%, of the total imports. Consolidation of species wise data in respect of raw drugs harvested from wild (forest area) obtained from 9 states of India, representing more than 52% of the forest area of the country adds up to 1,020,000 MT of botanicals per annum of the 960 traded medicinal plant species, 178 are consumed in volumes exceeding 100MT per year accounting for about 80% of the total industrial demand of all the botanicals in India. Analysis of these plants reveals 21 species (12%), are obtained from temperate forests, 70 species (40%) from tropical forests, 36 species (20%) obtained largely or wholly from cultivations/plantations, 46 species (25%) obtained largely from road side and other degraded land use elements and the remaining 5 species (3%) imported from other countries. The above mentioned 93 medicinal plant species sourced from Indian forest including guggul and agar need appropriate attention including the temperate and alpine herbs and the tropical trees from the most vulnerable group of species that needs immediate management focus [55]. The following 36 species sourced wholly or largely from cultivation need to be improved upon in order to have better cultivars or varieties and making their germplasm available to the growers in adequate quantities for enhancing their income. Raw materials pertaining to the following five species are largely obtained through imports. Two of these species, namely *Aquillaria agalacha* (Agar) and *Commiphora wightii* (Guggul) do occur in tropical India, but their wild populations are able to meet only a fraction of the total domestic requirement. Efforts need to be exerted to build up wild populations of these two species by spreading their seeds in the forest mostly especially among the plants they can do very well and their harvest should be legally prohibited. About 80% of the plants are the basis of traditional Chinese medicine. Approximately 5,000 plant species are commonly prescribed by doctors of Chinese medicine and these can be available in raw, processed or concentrated forms. About 140 new drugs have originated directly or indirectly from Chinese medicinal plants by means of modern scientific methods, pointing to pharmaceutical potentials of the plants. China has the greatest asset that amounted to 827 billion USD derived from non-commodity [21]. In China, the number of species domesticated and cultivated by farmers increased from estimated 100 – 250 [56] to about 400. A total of 11,146 medicinal plant species are cultivated in top provinces of China. In the Philippines, medicinal plants are considered to be one of its natural living treasures. There are around 1,500 medicinal plants from the Philippines 13,500 plants species of which more than 3,500 are considered indigenous, only 120 medicinal plants have been scientifically validated for safety and efficacy [57]. In Malaysia 2,000 species from 15,500 flowering plants have been reported to have medicinal properties and many have been scientifically proven. Besides China and Europe, Arabs are the largest users of herbal medicines [58]. Malaysia is one of the origins of banana and has around 50 types of banana with capacity of exportation [59]. It is estimated that only 15-20% of the population of Nepal-living in and around Urban areas have access to modern medicinal facilities, whereas the rest depend on traditional medicine [60]. The Bilad As-Sham which comprises Jordan, Palestine, Syria and Lebanon has about 4,500 species belonging to Six biogeographical regions, Lebanon with 2,800 species is the richest area, almost 25% of the species are medicinal plants [61]. Sumerians in the Middle East were the first to brew beer in 7000BC. These people had lived upto 2004BC [62]. Southern Oman is a regional centre of

endermism with the majority of Oman endemics there, only a few endemic species occur in the central desert. Many species of the plant in United Arab Emirate remain data deficient, but of those for which the status is known, 12% are critically rare. There are 91 (designated protected areas (amounting to nearly 40% of the land surface). But protections are poorly implemented if at all, in the majority. There are no areas primarily for plant conservation [63]. Saudi Arabia covers 80% of the total area of the Arabian Peninsula and has the Empty Quarter (ocean of sand) considered being the longest stretch of deseart in the world. It covers an area of 250,000 km^2. The coastal boundary of Saudi Arabia with red sea may have high number of plants. The richness of Turkey's climates, topography and geomorphology has resulted in a great richness of plant diversity. More than 500 species are used for medicinal and aromatic purposes [42].

4.2 Europe

The estimated values of vascular plant species, medicinal plants and plants endemic to european countries are given in Table 2. About 72,000 plants can be found in Ireland and United Kingdom which is made up of Great Britain (England, Scotland, Wales and Northern Ireland).

However, about 4,500 new names are added each year, and also for corrections, additions and amendments to the exisiting entries [83]. Plant endemism is one of the most important indicators to evaluate environmental value of an area. In Turkey, the country that boarders Europe and Asia, the rate of endemism in plant species is relatively high when compared with other European countries [84]. Ukraine has 25,000 including nearly 4,000 aquatic plants, 15,000 fungi, over 1000 lichens and nearly 800 mosses. The vascular plants numbers 4,523 species, whereas in Belarus, 1,460, Moldova, 1,762 and Poland 2,300 species. Over 400 vascular plants are endangered in Ukraine [85].

There are 12,500 vascular plant species in Europe with 28% of the plants being endemic to the region [86] but more recent figures indicate that 20,000 – 25,000 vascular plant taxa are in Europe. The areas with the highest plant richness in Europe are in the Mediterranean region, the Iberian peninsular and Balearic Islands have around 7,500 taxa [87], followed by Italy with 6,711 species [33]. In Greece, the total number of species is around 5,700 and in France, it reaches 4,630 species. Greece is the country with the highest concentration of native plant species in Europe [88]. An estimate of 150 European medicinal and aromatic plants is threatened in at least one European country by trade and habitat loss [89]. A list of 401 nationally threatened plant species classified as extinct (2), possibly extinct (2), endangered (87), vulnerable (85), rare (214) and indeterminate (11) in Croatia. The indigenous flora of Estonia includes approximately 1,500 vascular plants. More than 500 plant species are situated on the margin of their distribution area: 121 on northern, 128 on northeastern, 45 on the eastern, 56 on the southeastern, 27 on the southern, 11 on the southwestern, 15 on the western and 52 on the northwestern margins. About 145 species consist of rare, endangered species and species of scientific value [90]. Of 3,144 different species of indigenous and introduced plants found in Switzerland 1,534 taxa are considered as not threatened, 191 are not classified, 990 taxa are on the Red List, and 429 species are listed as nearly threatened. Fifty (50) species out of the 990 on the Red List are now extinct in the wild in Switzerland, 180 are critically endangered, 321 are endangered and 438 are vulnerable [91]. Cicova reported that 150 domestic and 70 imported species of plants with curative effects are used in Slovakia [68]. From all the wild native plants in Romania, a total of 3,700 which represent 30% of vascular European flora [92] only 57 species are cultivated by agricultural companies and family farms [42]. Romania is considered an important meeting point between biographical regions and ecosystem, linking Europe and Central Asia. Prior to anthropogenic influences, the territory of today's Romania consisted mainly of forests (27%) and steppe grasslands (16%), aquatic ecosystems and wetlands (5-8%), and alpine and subalpine ecosystem (1.2%). The Iberian Peninsula is one of the greatest centers of diversity for medicinal and aromatic plants in the world. However, the plants are threatened because the genetic diversity that characterizes this region is in the process of dilapidation and loss as a result of occupation and progressive transformation of the natural habitats. The collection of 219 samples of medicinal and aromatic plants was included in germplasm collections [93]. One in every 3 Europeans uses non-orthox medicine including traditional medicine as part of health care system [94]. Australian aboriginals, New Zealand Maoris, North American Indians, Africans, Pacific Islanders and the peoples of Latin America continue to make important contributions to their

national cultures and fulfilling healthcare needs [95].

The Maltese Archipelago is a group of small islands with relatively high plant biodiversity of 1,264 vascular plants. About 455 plant species have been used in the past to treat medical conditions [83]. Species of the labiatae family account for 7% of the total local medicinal flora [96]. This family ranks second after the compositae family (15%). Out of the known1,500 spontaneous species of vascular flora in Lithuania, 462 species are considered as medicinal and aromatic plants used in traditional

Table 2. Distribution of human and vascular plant species in Europe

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
Romania	21,711,000	230,300	94.27	3700	551	148
Malta	416,333	316	1,317.51	1,264	458	-
Lithuania	3,431,000	64,800	52.95	1,500	462	286
Belgium	10,827,519	30,510	354.88	578	-	-
Greece	11,306,183	131,940	85.69	5,700	377	133
Iceland	317,900	103,000	3.09	45	-	-
Georgia	4,900,00	69,700	70.30	4,500	2,000	380
France	65,447,374	547,030	119.64	4,630	900	-
Latvia	2,237,800	64,589	34.65	>1,400	-	-
Liechtenstein	35,904	160	224.40	-	-	-
Luxembourg	502,209	2,586	194.2	-	-	-
United Kingdom	62,041,708	244,820	253.42	-	-	-
Nertherlands	16,609,518	41,526	399.98	-	-	-
Norway	4,896,700	324,220	15.10	-	-	-
Ireland	4,459,300	70,280	63.45	-	-	-
Monaco	33,000	2.00	16,500	-	-	-
Nauru	10,000	21	476.19	-	-	-
Azerbaijan	8,997,400	86,600	103.90	4,500	1,500	270
San Marino	32,386	61	530.92	-	-	-
Armenia	3,238,000	29,800	108.66	7,350	>350	-
Germany	82,689,000	356,700	231.82	4,333	> 1,500	-
Serbia & Montenegro	10,503,001	102,100	102.87	3,250	700	223
Ukraine	46,481,000	579,400	80.22	5,100	479	600
Sweden	9,366,092	449,964	20.82	-	-	-
Belarus	9,755,000	207,500	47.01	1,460	279	-
Moldova	4,206,000	33,851	124.25	1,762	337	-
Poland	38,530,000	304,400	126.58	2,500	260	-
Austria	8,372,930	83,858	99.85	4,712	1,850	-
Croatia	4,551,000	55,900	81.41	8,871	900	523
Cyprus	835,000	9,260	90.76	2,283	436	141
Czech Republic	10,512,397	78,866	133.29	2,499	973	-
Estonia	1,340,021	45,226	29.63	1,500	584	-
Italy	60,340,328	301,230	200.31	6,711	2,359	-
Switzerland	7,782,900	41,290	188.49	3,144	150	-
Slovakia	5,426,645	48,485	11.10	4,611	220	-
Hungary	10,098,000	92,300	109.40	2,214	270	-
Finland	5,366,100	337,030	15.92	1,102	131	-
Albania	3,195,000	28,748	111.14	3,250	>300	187
Slovenia	2,062,700	20,273	101.75	3,200	400	-
Macedonia Republic	2,048,620	25,333	80.87	3,500	> 700	-
Bulgaria	7,726,000	110,600	69.86	3,900	750	498
Bosnia & Herzegovina	3,760,000	51,209.2	73.42	3,298	-	-
Great Britain	-	-	-	1,600	-	-
Spain	46,951,532	504,782	93.01	5,050	1,069	1,650
Denmark	5,540,241	43,094	128.56	-	-	-
Monaco	35,000	2	17,500	417	156	42

- = unknown; information from references 60,64 – 82,206

medicine. The medicinal florae belong to 87 families. The group families under usage are Lamiaceae, Apiaceae, Ranunculaceae, Asteraceae and Solanaceae. The indigenous species comprised 62% of all species used as medicinal plants, introduced species (28%) and alien (10%). Rare and/or endangered species make up 43% of medicinal and aromatic plants in Lithuania [72]. More than 300 species are identified as aromatic and medicinal source of economic revenue; 182 of them are regarded as common [84]. The flora of Albania includes 3,250 plant species that is about 30% of the European Flora [73]. There are 30 endemic species, endangered species and relict species [71]. More than 200 medicinal and aromatic plants growing in the meadows and pastures of Serbia were classified into 136 genera and 49 families with a predominance of hemicryptophytes (65.91%) and geophytes (10.23%) [64]. Yugoslavia is part of the Balkan Peninsula. Its whole territory covers 102,173 km^2 with five main biogeographic regions; Mediterranean, Central European, Pontic, Boreal and Central European Mountainous [65]. Yugoslavia is one of the 158 world biodiversity centres having 4,700 plant species. Approximately 3,200 plant species known to be indigenous or well adapted to the Slovenian climate, 400 have medicinal values and 10% are considered to be endangered (34 have been harmed, 77 are vulnerable, 192 are rare) [68]. About 118 plant species are threatened, 5 species sensitive to habitat alteration, 4 vulnerable and 133 species are of special interest [97]. Macedonia is very rich in plant diversity, having approximately 3,500 vascular plant species, and is at the top of the list of countries called European hotspots. More than 700 plants in Macedonia have medicinal values but only about 150 species are used frequently [77]. Out of the reported 30.6% of 2,359 medicinal plants found in Italy, 723 are considered as threatended. The Amazon has approximately 16% of all the plant species that exist on the earth, and this wealth increases towards the west of the region [60]. There is no reliable figure that represents the total number of medicinal plants on earth and therefore national or regional estimations vary considerably [98].

4.3 Americas

Table 3 shows the populations of vascular, medicinal and endemic plants of North America comprising USA, Canada and Canaan Island and South America. For example, Columbia, Ecuador, Peru and Bolivia cover approximately 2.5% of earth's terrestrial area or 21% of South America but harbor 12-22% of world's flora or 55% of the South America flora, and the percentage of endemics in each country is 25-30%.

Table 3. Distribution of human and vascular plant species in the North and South America

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
USA*	309,975,000	9,629,091	32.19	21,641	2,564	-
Canada	34,207,000	9,976,140	3.43	5,111	1,000	3,859
Canaan Islands	-	-	-	1,594	619	-
Portugal	10,636,88	92,391	115.3	5,050	219	392
Peru*	29,461,533	1,285,220	22.92	25,000	6,250	5,581
Brazil	193,364,000	8,511,965	22.72	56,215	-	-
Guyana	761,000	214,970	3.54	6,409	-	-
Venezuela	28,888,000	912,050	31.67	21,073	≥800	-
Suriname	524,000	163,270	3.21	5,018	-	-
Ecuador	14,228,000	283,560	50.18	19,367	228	4,433
Bolivia	10,031,000	1,098,580	9.13	17,367	311	-
Colombia*	45,569,000	1,138,910	40.01	51,220	5,000	-
Uruguay	3,372,000	176,200	19.14	-		
French Guiana	-	-	-	5,625	-	-
Chile	17,114,060	756,950	22.61	5,284	469	-
Paraguay	6,460,000	406,750	15.88	7,851	3,500	-
Argentina*	40,518,951	2791,800	14.51	10,937	1,531	820

*- = unknown; information from references 99-110; * = highly populated*

In Buenos Aires Province of Argentina 369 species of vascular plants has been reported as threatened from which 71 has medicinal uses. Argentina is one of the 25 most countries in the world that has 10,937 species [110]. Mexico has a total flora of 30,489 (Table 4) placing Mexico forth in ranking countries with the most species of vascular plants after Brazil, Columbia [111] and China.

About 95% of Haleakala National Park (that above 600 m) in Hawaiian State of USA is dominated by native species. This biota consists of 246 species of flowering plants, 104 ferns, 173 mosses and liverworts. Over 90% of these species are endemic to the Hawaiian Islands and many are endemic to Maui [123].

The floristic diversity of the Caribbean, presents a complex nature of continental ecosystem of North and South Americas, exotic species, and endemic plants. Haiti, Cuba and Dominican Republic represent biogeographic areas with numbers of endemic species [109]. Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica and Panama have threatened species of 477, 49, 84, 86, 134, 799 and 838 respectively. Central America has 8% of the world`s known plant species. The species that are either rare or threatened in Cuba (960), Jamaica (428), Puerto Rico (515), Trinidad and Tobago (863), Guadeloupe (13), Martinique (13), Dominica (25), Bahamas (21), St. Lucia (19), Cayman Islands (6), Bermuda (14) and Mona (43) may pose serious problem to plant biodiversity in the Caribbean. Fungal species have been inventoried in Cuba (2,200), Puerto Rico (789), Dominican Republic (699) and Trinidad and Tobago (407). The species are highly threatened by deforestation, pollution and human

Table 4. Distribution of human and vascular plant species in Central America

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
Mexico*	108,396,211	1,972,550	54.95	30,489	>5,000	15,854
Haiti	10,188,000	27,750	367.14	5,242	-	-
Dominican Republic	10,225,000	48,730	209.83	5,657	150	-
Barbados	270,000	431	626.45	723	119	4
Puerto Rico	3,958,000	9104	434.75	3,900	604	236
Jamaica	2,651,000	10,800	245.46	3,699	606	1,147
Trinidad & Tobago	1,344,000	5,128	262.09	2,975	488	282
Cuba	11,269,000	109,800	102.63	6,522	1,491	1,960
Guadeloupe	457,100	1780	256.80	1959	321	19
Dominica	79,000	750	105.33	1,352	222	14
Martinique	404,000	1100	367.27	1,772	290	35
Lesser Antilles	203,000	6500	31.23	2,713	444	374
Bahamas	346,000	13,940	24.82	1,316	216	145
Panama	3,322,000	78,200	42.48	9,915	1,476	1,305
Costa Rica*	4,640,000	51,100	90.80	12,119	1,722	662
Nicaragua	5,822,000	130,000	44.78	7,590	1,148	63
El Salvador	6,881,000	20,700	332.42	3,500	410	18
Honduras	7,616,000	112,070	67.95	6,000	984	150
Belize	322,100	22,966	14.03	4,423	725	53
Guatemala	14,377,000	108,890	132.03	8,681	1,132	168
St. Vincent & Grenadine	119,000	388	306.70	1,765	289	26
St. Lucia	174,000	616	282.47	1,186	194	12
Grenada	103,000	345	298.55	1,094	179	4
Montserrat	104,000	344	302.33	800	131	32
Cayman Islands	57,000	4033	1413	601	98	24
Saba	-	-	-	504	188	3
Bermuda	65,000	53	1226.42	472	176	38
St. Eustasius	-	-	-	464	173	2
Vergin Gorda	25,383	352	72.11	403	150	1
Saint Barthelemy	7,490	21	356.67	344	128	-
Anquilla	16,000	102	156.86	321	119	1
Saint Kitts & Nevis	43,000	262	164.12	1,007	375	-
Antigua & Barbuda	89,000	443	200.9	1,145	427	-
Anegada	-	-	-	198	74	2

*- = unknown; information from reference 111 – 122,206; * = highly populated*

encroachment [108]. Year-round moderate temperatures, abundant rainfall and rich soils make tropical Latin America home to nearly 100,000 of the world`s known over 400,000 species of higher plants, and therefore home to intold numbers of potential cures. There are about 380 genera comprising 3,000 species of which currently 1,994 species have been recognized in the Asteraceae in Mexico [124].

Central America is the least known part of the world, yet it is extremely rich in number of plant species of over 400,000 flowering plants, 17,000 species live in Central America. With continued plant exploration and taxonomic studies, these figures could rise, since in the neotropics as many as 10,000 species of vascular plants may be undescribed [115]. Floristic knowledge of Central America is still quite limited but has improved greatly in the present, perhaps because of the need for new therapeutic agents that can be used to combating new emerging infectious diseases. The concept of endemism is relative, and often based on artificial limits such as political boundaries; this is well illustrated in Central America. For example, the family Rubiaceae in Costa Rica has some 405 species, including cultivated, adjunct and possibly occurring species. Removing those three categories of plants, it may be assumed that the Rubiaceae is represented in Costa Rica by 345 species of which 66 are endemic (19%) to Costa Rica. Discovery of new families of flowering plants is uncommon. However, Ticodendraceae was described in 1991 as a result of research conducted in Costa Rica. Intensive collection in Costa Rica has also resulted in the discovery of many monotypic genera e.g. Gamanthera and Povedadaphne (Lauraceae) and Panamanthus and Gaiadendron (Loranthaceae) [58].

Hence, Latin American countries have witnessed prepondarance of research works on medicinal plants in the period between 1984 and 2004 as compared to before 1984. For example, full papers published by some selected Latin American countries on plants in the period of 1984-2004 are Brazil (3,722), Mexico (1,781), Argentina (1,741), Chile (573), Venezuela (394), Colombia (265), Peru (214), Cuba (184) and Uruguay (69) [103], pointing to increased exploitation of plants for medicinal principles and uses. After all, the South America alone may hold as many as 90,000 species [123]. The northern Andes are often considered the premier biodiversity hot spot on earth, although this is not based on plants alone. The concept of hot spot is defined as area of high plant biodiversity and high level of endemism that should be conserved to save the highest number of species. Peru is among 12 most biodiversity rich or mega-diverse countries of the world with 25,000 plant species and 5,354 are endemic [111].

4.4 Africa

Table 5 shows distributions of human and vascular plant species in Africa. The continent is highly enriched with medicinal plants. The Iberian Peninsula and North West Africa are considered to be the centre of diversity [144].

It is estimated that about 27 million South Africans use herbal medicines from more than 1,020 plant species. A total of 166 medicinal plant species that provided 525 tonnes of plant material valued at about R27 million are traded annually in the Eastern Cape Province of South Africa [137]. Nigeria florae contain 7,349 species of higher plants alone [128] and have made serious impacts on the health and wealth of Nigeria [129] and could be an enormous source of foreign exchange for the country [130]. Many of the Nigerian medicinal plants are collected in the wild and only a few are cultivated domestically [131]. Nigeria can earn about $1 billion dollars annually from sales of herbal medicine. If herbal medicines were properly harnessed, they could be veritable revenue earner for the country because of its high level of global recognition [158]. Africa is the world's second largest continent after Asia, both in terms of area and population. The continent has a unique diversity of geographical and climatic factors and exceptionally rich varied florae with an estimated 68,000 plant species, of which about 35,000 are known to be endemic. Madagascar was renowned for the highest percentage of plant species endemism in the world. The continent second to Asia in export figures. The global market of herbal drugs is estimated to be about US $60 billion per year, growing at a rate of 70% [143]. Northern Africa has about 10,000 plant species of which around 70% are known to be valuable as food and medicines among other uses. Africa accounts for only 5% of global pharmaceutical trade. North Africa includes Algeria, Egypt, Libya, Morocco, Mauritania and Tunisia [6] and 90% of Libya land is desert with scattered oases [144]. The Mediterranean region that boarders North Africa is one of the 25 internationally recognized biodiversity hot spots in the world and it has extraordinary plant diversity and species

endemism. Morocco has the highest rate of species endemism in the region. The Egyptian pharmaceutical industry was worth US $649.60 million in 2000 while the annual import of herbal medicine was US $1.9 million in 2000. Most of the imports originated in China, Taiwan and India. No wonder that in the biblical story when Joseph's jealous brothers sold him into slavery, he was purchased by a caravan coming from Glead (Jordan), their camels bearing gum, balm, and myrrh on their way to carry it down to Egypt [159]. Also in 1874, in the valley of the Tombs near Luxor, the German Egyptologist, George Ebers discovered the world's oldest surviving medical text, a 65-foot papyrus dating from shortly after the time of Joseph, around

Table 5. Distribution of human and vascular plant species in Africa

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
Nigeria	170,123,000	923,768	184.16	7,349	≥ 2,000	205
Congo	3,999,000	342,000	11.69	6,000	950	1,200
Lesotho	2,084,000	30,355	68.65	1,591	-	2
Mozambique	23,406,000	801,590	29.20	5,692	570	219
Zambia	13,257,000	752,614	17.61	6,000	78	211
Benin	9,212,000	112,620	81.80	2,500	-	0
Cape Verde	513,000	4,033	127.20	774	-	86
Gambia	1,751,000	11,300	154.96	974	-	0
Sierra leone	5,836,000	71,740	81.35	2,090	284	74
Guinea	10,324,000	108,890	132.03	3,000	-	88
Guinea Bissau	1,647,000	36,120	45.60	1,000	-	12
Cote d'Ivore	21,571,000	322,460	66.90	3,660	-	62
Liberia	3,476,608	111,370	31.22	2,200	-	103
Mauritania	3,366,000	1,030,700	3.27	1,100	-	0
Niger	15,891,000	1,267,000	12.54	1,460	-	0
Egypt	78,848,000	1,001,450	78.73	2,121	≥ 577	70
Congo DR	67,827,000	2,345,410	28.92	11,007	2,721	1100
Burkina Faso	16,287,000	274,200	59.4	1,100	300	-
Senegal	12,861,000	196,190	65.55	2,086	200	26
Togo	6,780,000	56,785	119.40	3,085	-	-
Gabon	1,501,000	267,667	5.61	6,651	-	-
Sudan & South Sudan	36,233,000	2,505,810	14.46	3,137	-	50
Djbouti	879,000	23,000	38.22	-	-	-
South Africa	49,991,300	1,219,912	40.98	23,420	3,000	18,736
Kenya	40,863,000	582,650	70.13	>10,000	≥1,200	-
Algeria	35,423,000	2,381,740	14.87	3,164	≥859	250
Uganda	33,796,000	236,040	143.18	5,406	2,000	-
Morocco	31,892,000	446,550	71.42	4,200	1,000	650
Ghana	24,333,000	239,460	101.62	3,725	2,000	43
Madagascar*	21,146,000	587,040	36.02	17,000	3,265	9,840
Central African Republic	4,506,000	622,984	7.23	3,602	-	100
Chad	11,274,106	1,284,000	8.78	1,600	-	-
Angola	18,993,000	1,246,700	15.23	5,185	40	1,260
Mali	14,517,176	1,240,000	11.71	1,741	473	11
Somalia	9,359,000	637,657	14.68	555	151	-
Libya	6,546,000	1,759,540	3.72	1,825	450	134
Equatorial Guinea	693,000	28,051	24.71	3,250	142	66
Sao Tome & Principe	165,000	1,001	164.84	895	93	134
Rwanda	10,272,000	26,338	390.20	-	-	-
Zimbabwe	12,644,000	390,580	32.37	5,930	593	232
Cameroon	19,958,000	475,400	41.98	8,260	>500	156
Namibia	2,212,000	825,418	2.68	4,667	764	687
Botswana	1,978,000	600,370	3.29	3,402	557	17
Swaziland	1,202,000	17,364	69.23	3,746	248	4
Malawi	15,692,000	118,480	132.44	-	64	49
Ethiopia	79,221,000	1,127,127	70.29	7,000	> 700	84
Kenya	40,863,000	582,650	70.13	6,506	-	-
Tanzania	45,040,000	945,087	47.66	10,008	350	1,122

*- = unknown; information from references 9,125 – 157,206; * = highly populated*

1500 B.C. The Ebers papyrus listed 876-herbal formulas from coriander, cardamen, fennel, fenugreek, garlic, gentian, ginger, juniper, mint, myrrh, opium, poppy, onion, sesame, saffron, and thyme. This represents about one-third of the herbs in today's Western herbal pharmacopoeia [148]. Signifying that the Western Herbal pharmacopoeia may have originated from one of the Asian countries perhaps Jordan and imported to Egypt, the ancient home of prophetic scholars who might have used such plants during their own times. About 30% of Libyan population relies on traditional medicine. Tunisia has about 2,196 reported vascular plant species of which 151 are rare, threatened or endemic. The forest region of the El-feija Mountain areas located in north-eastern Tunisia constitutes about 700 vascular plant species [144]. About 205 higher plants are endemic in Nigeria, out of this, 39 species are found in the north, 38 in the west and centre, and 128 in the east of the country [135]. However, over 90% of Nigerians in rural areas and about 40% in Urban areas depend partly or wholly on traditional medicine for health-care [134]. More than 200,000 out of over 400,000 vascular plants so far identified in the whole of our planet are in tropical countries in Africa and elsewhere [127]. The Congo basin forests cover 20% of the world's tropical moist forests in Africa. It is also one of the most biologically diverse and poorly understood ecosystems of the African continent [160]. There are about 40,850 plant species of which about 6,500 are reported to be endemic and 175 of these are rare [148]. There are about 24,000 vascular plants in South African countries and 4,000 of them are medicinal and aromatic. Cape Floristic Province has 8,600 species of vascular plants and 68% of them are reported to be endemic [144] and 13% are threatened. South Africa recorded (35), Mozambique (36), Angola (19), Malawi and Zimbabwe (14 each) [90], 58 species are extinct, 250 endangered and in Cape Floristic Province, 430 are threatened and 26 species are extinct [144]. The seven centres of endemism in Africa with high number of vascular plant species are Guineo-Congolian (8,600), Zambesian (8,500), Sudanian (2,700), Somali-Masai (2,500), Cape (8,500), Karoo-Namib (3,500), Afromontane (3000) with endemism; 80, 54, 33, 50, 86, 50 and 75 respectively [161]. The angiosperm's (flowering plants) include more than 250,000 herbs, shrubs and trees [144].

4.5 Australasia

Table 6 shows the distribution of vascular plant species including those with medicinal values found in Australasia. Australia has 15,638 species of vascular plants, 14,458 species are endemic (5.8%) of the world endemic translating to 249,276 global endemism. But 1,072 species of plants are threatened and 83 plant species are extint in Australia [16,21].

4.6 Estimation of Flowering Plants

The estimates of vascular plant species on the earth as reported by Bramwell [9] and Govaerts [2] were between 250,000 and 422,000 based on 1,015,000 binomials in Index Kewensis [1]. Evans reported that current estimates of the number of species of flowering plants range between 200,000 and 250,000 in some 300 families and 10,500 genera [167]. Total number of Medicinal plants reported from various parts of the world is either underestimated or overestimated as evidenced by findings from researches carried out on plants biodiversity. For example, different systems of Unani and Ayurvedic medicine (Eastern medicines) are largely based on the medicinal properties of plants, yet the precious wealth of indigenous knowledge is in danger of being lost [2].

Table 6. Distribution of human and vascular plant species in Australasia

Name of country	Human population	Area sq.km	Population density sq.km	Plant population	Medicinal plant population	Plants endemics
Papua New Guinea	6,888,000	462,840	14.88	11,544	-	-
Palau	20,000	458	43.67	-	-	-
Fiji	854,000	18,270	46.74	-	-	-
Kiribati	100,000	811	123.30	-	-	-
Marshall Islands	63,000	181	348.07	-	-	-
Micronesia	111,000	702	158.12	-	-	-
Solomon Islands	536,000	28,450	18.84	-	-	-
New Zealand	4,383,600	268,680	16.32	2,391	-	-
Samoa	179,000	2,944	60.80	693	74	-
Australia	22,421,417	7,686,850	2.92	15,638	-	14,458

- = unknown; information from references 16,21,162-166,206

About two-thirds of medicinal plants in use are still harvested from the wild and between 4,000 and 10,000 of them may now be endangered [9].

For large, species-rich groups such as seed plants, synonymy and the number of un-described species remain the two largest obstacles to understanding how many species there are. The available data demonstrate that, given a complete taxonomic account or monograph for a group, synonymy rates are uniformly high for a range of taxa. Rather than monographs, underestimate rates, of synonymy and overestimate species numbers are worthy of consideration when estimating total number of plants in the earth planet. About 70% of plant species found in the wild have medicinal, aromatic and other uses and over 10% of these have the potential for commercial exploitation as a resource for pharmaceutical industries [168]. Continuous exploitation of several medicinal plant species from the wild and substantial loss of their habitat during the past 15 years have resulted in the population decline of high value medicinal plant species over the years. Deforestation, farming, urbanization, excessive exploitation and negligence may be the factors responsible for the extinction of some food crops and medicinal plants in the earth planet. Therefore, there is need for radical step towards identifying and taking census of all the plants in the earth planet with a view to conserving the plant biodiversity for medicinal and economic sustainability. The biomass/biota of the earth is seriously dynamic due to natural and human factors. For example, 70% of the world's species is found in 12 countries: Australia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, India, Indonesia, Madagascar, Mexico and Peru. The entire Hindu Kush-Himalayan belt has an estimated 25,000 plant species comprising 10% of the world's flora [169]. Tropical regions support two-thirds of the estimated total number of vascular plant species [170].

The increased popularity of medicinal plants has increased the interest of pharmaceutical industry in the production of drug raw material that is from large number of wild species. So disproportionate and uncontrolled collections of wild plants will inevitably cause extermination of a large number of species. Indeed, the natural resources of medicinal plants are steadily decreasing on a plant wide scale. Hence, the modern civilisations have to stop to act like predators, quickly causing within a few decennia the vanishing of uncountable number of species, thus depriving future generations of something, their ancestors were able to preserve for millennia [171].

4.7 Ethnopharmacological Importance of Medicinal Plants Estimation

But about 10% of over 400,000 known species of plants have been screened in laboratories to determine their therapeutic potential [172]. The world market for herbal remedies was worth 19.4 billion US$ in 1999. The global demand for medicinal plants is increasing and, in India alone, the market is expanding at an annual rate of 20% [140]. Two hundred metabolites were produced by in vitro tissue, organ and cell cultures of hairy root, shoot, callus, shootlet, multiple shoot, callus and suspension. Some of the plants produce Phenolic compounds categorized into 15 main classes with over 8,000 identified compounds. The largest category is the flavonoid group, comprising 13 classes with over 5,000 compounds [173]. In plants, polyphenols are important for structural support, as anti-herbivorous, attracting pollinators, protection from ultraviolet radiation and wound repair [78].

The global market of herbal drugs is estimated to be about US $60 billion per year, growing at a rate of 79% [144]. About 80 Nepalese plant species with a volume of 1,000 tons are exported annually and form 2% of the foreign exchange of the kingdom. The basis for any industrial activity concerning medicinal, aromatic and essential oil plants forms a reliable raw materials supply from control wild collection and cultivation in agroforestry which have to be legally regulated to save majority of plants that are still harvested from the wild without any control. Therefore, implementation of industrial cultivation allows interfering [83]. The Egyptian pharmaceutical industry was worth US $649.60 million in 2000. The annual export of medicinal plants is more than US $43.17 million. High quality crops such as chamomile, fennel, and peppermint have the potential to boost Egyptian exports [144]. Medicinal and aromatic plants exported by Morocco worth US $168.91 million in 1994 [174]. Between 1992 and 1995, Morocco exported 6,850 tonnes of medicinal plants worth US $12.85 million to international market [144]. The total export of essential oils from Tunisia was US $2.4 million in 1996 [174]. Over exploitation of medicinal plants in West Africa has threatened the existence of 119, 115, 101, 46 and 43 in

Nigeria, Ghana, Cote d'Ivore, Liberia and Sierra Lone respectively [144]. Nigeria is the second largest supplier of Gum Arabic to the international market with an annual production of 4,000 to 10,000 tonnes [175]. A family can harvest a quantity equivalent to about US $630 per annum. The medicinal plants value in Uganda worth about US $40 million. Besides Sudan, Ethiopia is the world's largest producer of olibanum resin, 23000 tonnes of it was produced in 1981 of which nearly half was exported [174]. Kenya is the major supplier of Pyrethrum (*Tanacetum cinerariifolium* (Trevir). Sch. Bip.) to the world market. Owing to the lack of processing facilities, production has declined from 16000 tonnes in 1992 to 6000 tonnes in 2000. (Oil product (K)) Limited is the major producer of pyrethrum in Kenya. Besides supplying the local market, the company also exports mosquito coil manufactured from medicinal plants to Tanzania, Uganda, Sudan, Zimbabwe, Malawi and Japan [144]. Somalia is the world's largest exporter of myrrh (*Commiphora myrrh*), *C. katat, C. erythraea, Boswellia sacra* and *B. trereana* resins. The export of these resins was estimated at US $156million on the international market. The production of the resins has declined due to political instability in the country [176]. The annual export value of medicinal and aromatic plants from Sudan was US $10 million in the period between 1995 and 1999. In 1999, Tanzania exported medicinal products worth about US $6.9 million.

Madagascar with 2% of African's landmass has about 12,000 species of vascular flora not found elsewhere in the world. It is home to 25% of African plant species, and many still have to be discovered. Almost 90% of Madagascar's forests have been cleared for logging and agricultural purposes [174]. Habitat destruction and over exploitation of plant resources has endangered species such as *prunus africana* in Madagascar and *Cyeas thouarsii* and *Cyathea spp*. in Comoros [144]. In 1995, the medicinal plant export from Madagascar was US $4.64 million. The number of threatened plant species is high in Cameroon (155), Gabon (11) and Congo DR. (33) [174]. Medicinal plants of South Africa worth US $60 million and could generate up to US $220 million and 400 medicinal plants are in danger [144]. In Zambia, annual trade in medicinal plants is worth over US $43 million. The global market value of pharmaceuticals derived from genetic resources is estimated at US $75-150 billion annually. Earth provides services worth a minimum of US $16-54 trillion to humans per year compared to the global total gross natural product (GNP) of US $18 trillion [177]. But failing to act on climate change can cause reduction on gross domestic product (GDP) of 5-20% every year, with around 15 to 40% of species potentially facing extinction after only 2% of warming. Therefore 18.8 million Km of the total earth is protected with 17.1 million Km in terrestrial area (11.5% of the global surfaces) bearing in mind that only 30% of the earth is surface land, the remaining 70% is covered by water [9]. For example, increasing demands and an uncontrolled destructive collection are leading to a rarefication of *Harpagophytum procumbens* used for chronic rheumatic disorders on its natural site. Cultivation of *Harpagophytum procumbens* was considered, and selection and multiplication of a high quality Devil's claw chemotype was started in Namibia. The discovery of the anticancer agent Taxol in the bark of the pacific yew (*Taxus lacerifolia*) gave rise to destructive harvesting of this material in the North West USA and the industry turned to the use of *Taxus baccata* as the main source of Taxol and other related derivatives [16]. *Arnica montana* is an essential and irreplaceable medicinal plant for Weleda, a multinational company that produces both beauty products and naturopathic medicines. The firm's annual needs are modest, nevertheless, the firm has to face and is willing to accept the fact that Arnica is protected in most countries especially Switzerland [64]. The Convention in Biological Diversity (CBD) ratified by 171 countries and the European Union, is relevant not only to the conservation and sustainable use of medicinal plants, but is central to core business issues for the pharmaceutical and phytomedicine sectors. Provisions of the convention and national laws that implement them require any company or individual seeking to collect wild and in some circumstances, cultivated, medicinal plants, whether for scientific research or as the starting point for commercial development, to obtain the prior informed consent of government authorities authorized to determine access [178]. Since US $20-25 billion must be sent annually to achieve effective conservation. The world market for herbal remedies in 1999 worth US $19.4 billion, with Europe in the lead (US $6.7 billion), followed by Asia (US $5.1 billion), North America (US $4.0 billion), Japan (US $2.2 billion and the rest of the world (US $1.4 billion). However, in 1996 China exported finished products of medicinal plants that worth US $3.7 billion [123]. Europe is the major trading centre for medicinal and aromatic plants globally, with imports into one European

country amounting to 44,000 tonnes in 1996 with 2,000 medicinal plant species marketed in Europe out of 2,500 marketed in international trade [98]. Only 15% of pharmaceutical drugs is consumed in developing countries [123].

The rate of discovery of new drugs from plants has been disappointing. Only 1 plant sample out of roughly 10,000 produces promising results in screening and only about 1 in 10 of these might pass to the market [142]. Approximately 90% of plants is still collected from forests. Only a few countries such as China, India, Indonesia, Nepal, Thailand and Vietnam produce medicinal and aromatic plants through cultivation on commercial scale pointing to increase in medicinal plants trade in Asia. During the period 1992 to 1997, Taiwan province ranked fifth in the world in terms of imports of medicinal and aromatic plants after Hong Kong, Japan, USA and Germany. Taiwan province pharmaceuticals grossed US $2.52 billion [48]. The export of herbal medicines in Republic of Korea was US $7.4 million in 2000. The fresh herb market in Japan is up to US $45 million. In 1997, the total output value of the Chinese herbal medicament industry was US $3.37 billion [194]. But the global Chinese medicine market is worth US $20 billion a year translating to about 70% of annual Nigerian budget. The estimated global trade in medicinal and aromatic plants was over US $60 billion in 2000 and is suspected to reach US $5 trillion by 2050. China and India are the world's leading exporters of medicinal and aromatic plants. Indonesia contribution to the global herbal medicine market was US $150 million in 2000 [179]. Malaysian herbal and medicinal plant industry is worth US $1.19 billion. In 2000, Malaysian exported US $79.64 million worth of medicinal and pharmaceutical products [48]. The annual Philippine herbal market was estimated at US $50 million compared to synthetic day sales of US $1 billion in 2001 [180]. Bangladesh produces herbal medicines that worth US $0.5 million every year. The present export volume of crude drugs from India worth US $ 850 and 2,000 million by 2005 and 2010 respectively. India exported finished Ayurvedic and Unani medicines worth US $ 127 million to countries including Germany, Hong Kong, Malaysia, Russia, UK and USA in the year 2000 – 2001 [48]. The estimated export value for April – May, 2003 was US $ 160.42 million. Nepalese export of essential oils increased from US $ 76.62 million in 1996 to US $ 126.06 in the period 1999 – 2000 [181]. The future of essential oil industry looks promising with foreign firms entering Nepal for the manufacture of soaps and detergents [182]. Total turnover of crude drugs in the country is worth US $ 2.06 million [183]. Sri Lanka exported US $ 1.13 million worth of medicinal plants to various countries [182] whereas the exports of spices and allied products are worth about US $ 55.60 million [183]. In the year 2000, licorice exports sales by Turkmenistan totalled approximately US $ 923 million. In the late 1980s, the annual value of medicinal plant exploitation in Afghanistan was estimated to be about US $12 million. The country exports liquorice to France, Japan, India and USA with an export value of around US $4.2 million per year. The potential pharmaceutical market of America is estimated to be US $50 million. In 1998, the value of annual sales was US $10 million. The actual market for pharmaceutical products in Azerbaijan probably exceeds US $80 million annually. The total volume of sales on the local market is worth US $67 million [84]. Iran exported herbs valued at over US $10 million to Persian Gulf states, France, Germany, India, Pakistan and Turkey.

The local production of drugs by Israel was US $1.25 billion [185]. Farmers produced and exported in 2003 fresh herbs worth almost US $100 million [48]. The export value of herbs and spices from Kuwait was US $ 12,066 in the year 1998 [171]. But estimated market value of medicinal and aromatic plants in Lebanon was US $18.6 million [186]. The pharmaceutical market of Saudi Arabia is the largest in the Gulf region. It is worth US $1.17 billion. The annual Turkish export of Dregano is worth US $16.5 million. About 130-140 plant species are cultivated in Europe, most of them are indigenous to the region. The overall collected plant material in Europe may be estimated to be at least 20,000 – 30,000 tonnes annually. At least 20,000 taxa are used on commercial basis in Europe with average imports of 120,000 valued at USD 335 million annually. The market is growing at 10-20% annually in Europe and North America over recent years. In USA, the herbal market is growing at a rate of 15-20% per year. Bulgaria became the biggest exporter of medicinal plants in Europe between 1992 and 1997. Medicinal plants from Bulgaria were exported to more than 20 countries [187]. An estimated 175 native North American plant species are harvested from the wild for use. *Panax quinquifolius* and *Hydrastis canadensis* are protected [188]. About 3,000 herbal remedies were found on the market in the UK – using some 400 different plants. Of the 700 or so

medicinal plant species used in UK, about 200 have a natural distribution in Europe [189]. With a view to conserving medicinal plants in France, the destruction, cutting, mutilation, uprooting, picking, or collecting, transportation, peddling, utilisation, sale or purchase of plant species are prohibited. In total 89 medicinal plant genera or species are fully protected throughout French Territory, while some other plant species are partially protected [190]. *Prunus africana* stocks are over exploited, so cultivation of *P. africana* can be a viable proposition. Turkey exports about 28,000 tons of medicinal and aromatic plants per anum, generating USD 50 million annually. The five species heavily harvested and exported in Turkey are *Ceratonia siliqua, Origanum spp, Capparis spinosa, Laurus mobilis* and *Glycychiza glabra*. The most threatened plant species in Turkey are *Acarus calamus, Ankyopetalum pypsophylloides, Ballota saxatilis subsp brachyodonta, Gentiana lutea, lycopodium annotinum, Origanum minutiflorum, Paeonia nascale, Rascus aculeatus, Gypsophila arrostii var nebulosa* and *Barha robertiana* [191]. Since the 12-mega divercity countries of the world comprise at least 60-70% of the world known plant species, ethnopharmacological importance of medicinal plants estimation should be emphasized in these countries where plants are the basis of all life of earth, and it is important that plant diversity is conserved for the benefit of future generations. In the face of uncertain future, an urgent priority must be conservation for as many plants as possible by way of an insurance policy [186]. The production of *Prunus africana* and Pyrethrum by African countries for the world market may likely pose threat to existence of the two plants [44].

Ethnopharmacology is at the intersection of the medical, natural, and social sciences. Despite its interdisciplinary nature, most ethnopharmaco-logical research has been based on the combination of the chemical, biological and pharmacological sciences. Far less attention has been given to the social science, including anthropology and the study of traditional knowledge systems [152]. Ethnopharmacological relevance of medicinal plants market does not only provide a snapshot of a country's medicinal flora, but also reflects local health concerns and the importance of medicine among its inhabitants [192]. For example, in southeast Puerto Rico, ethnopharmacological knowledge and the use of medicinal plants is decreasing due to an increase in the use of conventional medical care and to self-medication with over-the-counter pharmaceutical products. Because over 50% of prescription drugs are derived from chemicals first identified in plants, a 2008 report from the Botanic Garden Conservation International warns that cures for cancers and HIV may become extinct. They identified 400 medicinal plants at risk of extinction from over collection and deforestation, threatening the discovery of future cures. *Autumn crocus*, Yew and *Hoodia* are the examples. Unfortunately, the rain-forest is being destroyed, at such a rate that, thousands of species may become extinct before their medicinal potential can be examined. Because 5,000 years ago rain forest covered 2 billion hectares, (14% of the earth's land surface). Now only half remains, but it is inhabited by 50% of all the plants and animals found on the globe [193]. Humans are continuing to destroy an area equivalent to 20 football fields every day, a rate that if maintained will cause the rain forest to vanish by 2030. Slash-and-burn agriculture accounts for 50% of the annual loss. In 1990, 3.5 billion cubic metres of tropical wood were felled throughout the world [143]. The Amazon Indians use at least 1,000 plants medicinally. In Malaysia and Indonesia, more than twice this number of plant materials is used to make traditional medicine. Germany import at least 70% of finished herbal product on European market. Enormous market demand could have an irreversible impact on many species, unless action is taken to regulate trade [16]. Brazil, China and Nepal have conservation programmes, but India and Pakistan harvest from the wild. Presently *Taxus bacata* is endangered [143]. A link has been established between stunted plant growth and higher ultraviolet radiation caused depletion of the earth's protective ozone layer [16]. In addition, ammonia concentration has risen, with the effect of changing the pH of root water and directly affecting the chances of plants to survive in some habitats [194].

4.8 Over-harvesting is Responsible for Medicinal Plants Extinction

World's population hit 7 billion on 31st October, 2011 with 43% of the world's population under 25 years (1.9 billion of them are between the ages of 10 and 19). If the Africa's fertility rate remains unchanged over the coming decades, the continent will reach 15 billion in 2100. In most developing countries, particularly in sub-Saharan Africa the number of young people is growing very fast putting enormous pressure on governments to make urgent investments in

health and education since people under 25 years make up 60% in the least developed countries [177]. Statistics revealed that the world total fertility has decreased by nearly half in 50 years (from 5 children per woman in 1950 to 2.5 in 2015, with wide country variations). But 3.7 billion in their reproductive years will give rise to 9 billion human population by 2050. All these will give additional rise to the need for medicinal plants, which will lead to over-harvesting that may in part be responsible for medicinal plants extinction. After all, much of biodiversity loss due to Agriculture is occurring in Sub-Sahara Africa, South and South East Asia, and Latin America. These regions of the world have tropical forests and Savannahs, which are responsible for most of the annual exchange of carbon dioxide between the atmosphere and land surface. Long growing seasons and high rainfall create extremely tropical ecosystems [142].

Above all, major large of wild plants is harvested by poor households in developing countries [123], and adequate protection of some species can be achieved through increased regulation and the introduction of sustainable wild harvesting methods, a more viable long-term alternative is to increase domestic cultivation of medicinal plants [183]. It has been estimated that 14-28% of higher plant species are used medicinally and that 74% of pharmacologically active plant derived components were discovered after following up on ethno medicinal use of the plants producing a remarkably diverse array of over 500,000 low molecular mass natural products also known as secondary metabolites [200], such as alkaloids, glycosides, flavonoids, terpenes and coumarins [195]. Currently, medicinal plant research is one of the fastest growing areas of biomedical research. The total number of citations in PubMed from 1990-2007 containing the word “Phytotherapy” was less than 100 in 1990, but rose to over 1,000 in 1998, then to 12,000 in 2005 and to over 15,000 in 2007 pointing to serious increased harvesting. In 1999, the world market for herbal remedies was US $19.4 billion, with Europe in the lead (US $6.7 billion), followed by Asia (US $5.1 billion), North America (US $4.0 billion), Japan (US $2.2 billion) and the rest of the world (US $1.4 billion). As at 2003 over 50,000 plants were in use for medicinal purposes worldwide [196]. This trend of phytotherapy attained shows that natural products are back in fashion in the pharmaceutical industry. There are three main reasons for these which include 100 fold increments in the screening techniques that have made large natural product screening affordable [197]. Secondly, drug companies have realized that knowledge of traditional medicine can increase their probability of finding commercially valuable drugs and reduce research cost and thirdly there is a growing demand in industrialized countries for natural medicines. Between 1980 and 1992 United States National Cancer Institute paid for the collection of 23,000 plant samples of 7,000 species, almost all of which came from the South [198].

The current rate of extinction may be already as high as 10,000 time the natural rate. However, about 15,000 plant species may face extinction due to over harvesting and habitat loss [199], translating to the earth losing at least one potential major drug every two years. Each species of plant lost to extinction represents not only the potential loss of life-saving cures for diseases such as cancer or acquire immunodeficiency syndrome (AIDS), but also the loss of protein-or vitamin – rich foods or more productive and stable crops [200]. Since man’s dependence on plant has in no way decreased, there is need for comprehensive documentations of the plants exploited for their medicinal uses in some parts of the world. Some ethnic groups of the world may not be aware of the plants used to treat ailments in other ethnic groups. Because of migration due to war, hunger, business and other purposes, some plants stand chance of being transferred from one ecological environment to another and such plants may not be known by the people of that environment [49]. Medicinal plants species are very profitable. A 1995 analysis estimated that each year new plant derived drug is worth an average of $94 million to drug companies and $449 million to society. Sales of $24.4 billion from non-prescription and over the counter plant-based drugs were made worldwide in 1985 [201]. Herbal medicines represent an estimated $60 billion per year global market and some 20% of the overall drug market. Therefore, conservation of plant biodiversity would prevent or decrease environmental degradation and improve the health of humans and animals. Although Biodiversity hotspot is an area of rich biodiversity that has 1,500 endemic plant species with more than 70% of their original vegetation that faces serious threats to its existence [192]. About 68% of Madagascar plants exist nowhere on earth, 60% and 25% of plant species endemic to Ecuador’s Galapagos and Canary Islands are threatened with extinction [126]. Our biological heritage is disappearing at an alarming and

accelerating rate. We are currently losing between one and 50 species per day. Since the time of 20th century 97% of the varieties of 75 vegetable species in the US have become extinct [202]. If we continue current practices the world will lose a quarter of all our biological wealth by the middle of 21st century. For example, Mexico's Huastee Indian communities cultivate some 300 different plants in a mixture of small gardens, fields and plots. In Indonesian village, it is easy to find more than 100 different plant species all for food, medicine etc. if measures are not taken to curtail the destruction of biodiversity the communities would simply die [62]. The size of undisturbed ecosystems in the world has shrunk dramatically as global population and resource consumption have grown. For example, only 2% of the tropical dry forest along Central America's Pacific coast remains. Thailand lost 22% of its mangrove swamps between 1961 and 1985 due largely to prawn cultivation for export. In the US alone, sales of plant based drugs amounted to $15.5 billion in 1990 [203].

4.9 Recovery of Extinct, Endangered and Rare Plants

It has been well recognised that human health and well-being are directly dependent on biodiversity. For example, 10 of the world's 25 top-selling drugs in 1997 were derived from natural resources. Herbal medicines represent an estimated $60 billion a year global market and some 20% of the overall drug market [204]. The global market value of pharmaceuticals derived from genetic resources is estimated at US $75,000 – 150,000 million annually. It has been reported that US $1 per day is enough to provide the basic nutritional needs of an individual but about 1.3 billion people in the world earn less than this amount. But Zamiaceae (90.3%) Canellaceae (35%) Leguminosae (18%), Araliaceae (16.3%), Rosaceae (14.4%) Guttiferae (13.3%), Lauraceae (13), Menispermaceae (9.5%) and Apocyanaceae (7.5%) have been threatened whereas *Stangeria enopus, Warburgia elongate, W. salutaris, Dalbergia odorifera, D. torkinensis, Afzelia species*, West African *Garcinia species, Ocotea bullata, Stephania species* in South Eastern Asia and *Holarrhea floribunda* have been over harvested [33]. Therefore, there is need for recovery of many medicinal and nutritional plants. Successful management of vegetation and the restoration of threatened or endangered plant populations clearly depend on the factors that determine and limit plant abundance and distribution. Physical conditions, plant physiological responses and plant competitive interactions are often important [171]. Other factors include tropic interactions, such as those involving plant consumption by insects and pathogens are also critical to growth, reproduction and population dynamics of native plants [182].

The ultimate goal of rare plants recovery is to ensure that species with limited distribution and abundance have the highest possibility of long-term persistence and evolutionary viability [184]. The goal can be accomplished in the short term if target species have multiple populations in appropriate and protected habitat throughout their historic ranges. The minimum size and number of those populations depend on the taxon's life history, genetic system, breeding system, demographic responses to changes in the habitat, and other ecological characteristics. Therefore, no one formulation of population structure can be tailored to fit all plant taxa [134]. Estimates of minimum viable population size have ranged between 50 and 2500 plant species. But 500 plant species was suggested as a first approximation for most plant species. Presumably, the number of viable populations of a recovered species should be proportional to the former area of distinction; taxa that were wide-ranging should have more population than geographically restricted taxa. The distribution of populations should also correspond to the distribution of genetic variation within a species. Since widespread taxa tend to be more genetically variable than restricted taxa [116]. Conserved populations of widespread endangered taxa must include more genetic variation than those that are ecologically or geographically confined. This acts to preserve the evolutionary viability of a species by exposing the largest species to possible array of genes and gene combinations to the fullest palette of eco-geographic variation.

For example, the Furbish's lousewort meta-population appears to be declining; its annual population extirpation rate (2.6%) exceeded the establishment rate (1.3%) from 1980 to 1991 [183]. Almost 80% of the mixed-grass biome disappeared and the recovery of endangered plants requires that natural populations be within protected, appropriate habitat and able to maintain themselves over long periods of time [184]. The in situ conservation of endangered plants can be viewed as a five-part process; inventory, survey, habitat protection, monitoring

and recovery. In plant census, the number of plants counted in a rare population at flowering is compared with tallies from previous years. This concept of monitoring was advocated for as a tool for conserving rare plants [181]. But sometimes the census data are insufficient. There are at least five reasons why census data alone are insufficient, and sometimes misleading, for monitoring rare plants, designing recovery projects and evaluating recovery methods [186]. First, the number of plants counted per year is not necessarily significant to population biology or conservation. Change in the size of population is not always a matter of concern. In fact, great fluctuations in observed population sizes are the norm for some plant life forms (annuals, some herbaceous perennials) [179]. Second, significant change can be slow, and therefore difficult to detect over the relatively short time periods associated with typical bureaucratic or fiscal constraints. Five to fifteen years or more may be required to obtain a genuine trend, and during that period employees can leave, survey methods can change, budget can be cut, and interest in the project can fade. Third many rare plant taxa lack replicate populations, which are needed to determine the significance of detectable change. Fourth, change detected from census data for reproductive individuals has an obscure relationship to the population and to the species as a whole; seeds, seedlings, and juveniles might better indicate demographic change. Fifth, the biological processes that affect population stability (e.g. survivorship, fecundity, duration in the seed bank) must be known if meaningful management of the populations are to be enhanced or new populations are to be created within historic range, the recovery of rare plant populations is demographic and experimental venture. Habitat manipulation, transplanting potted plants, sowing seeds, and other restoration techniques have population-level effects that should be quantified and evaluated. By so doing, the prospects for species recovery (as may be defined in recovery plant) can be determined and used to make policy and economic decisions. The successful reintroduction of rare plants to the wild will depend upon knowledge of a species life history and habitat requirements, the consideration of key genetic, demographic and ecological traits that affect vulnerability to stochastic extinction process [184], and the identification of suitable restoration sites. Unfortunately for many rare plants, much of this information is lacking when recovery plans are proposed. As a result, the plans are often standardized, and the recommended research and management actions are too broad or are unrelated to immediate population survival [135]. In addition to that, species that depend on early succession or transient habitats in landscape mosaics present unique recovery challenges [185]. Therefore, the keys to implementing a successful recovery program for a rare plant, are effective demographic monitoring and the use of modern techniques implored for plant breeding. The techniques include cellular tot potency, suspension etc. The adoption of any of the techniques mentioned above is dependent on population trends of short-term studies [171].

It is possible to make reasonable decisions regarding population trends of plants from short-term studies. However, the benefits of protecting and restoring endangered species, including ecological stability, medical research, agricultural research and economic benefits [183] need to be re-emphasized. Because the soil in the tropics is very poor, and plants which grow rapidly do so due to their strong root system. In nature, aquatic and amphibious plants live in various types of still and moving water. Every type of natural water is characterised by certain peculiarities which influence to a greater or lesser degree the plant communities existing there. The qualities of these waters are variable but the constant qualities include soil, composition, nutrient and pH of water, temperature, transparency and velocity of the existing water [135]. Alien species may be predominant below 600m. For example, in spite of haleakala's role as part of one of the most viable conservation units in the State of Hawaii, United States of America, plant species are still sufficiently rare and threatened to merit listing. Seven plant taxa formerly native to the Haleakala Park are known to be extinct, and 15 others have been extirpated from the park in the last century. Active management has begun to reverse the chronic decline of the park's resources [182] despite biological invasions assisted by humans are impoverishing biological diversity worldwide. For instance, ecosystem of low and middle elevations of the Hawaiian Islands have been drastically altered. Biological diversity has eroded more rapidly in Hawaii than in any other state of US. However, only 19 Hawaiian plant species have been endangered [187]. It is estimated that 1,094 Hawaiian taxa of flowering plants, 10% are extinct, 12% endangered, 4% vulnerable and 12% rare. Many Hawaiian botanists consider these figures conservative. Several conservation groups filed suit against the US Fish and Wildlife Service for

listing few of the eligible Hawaiian species, and the Service agreed to propose 186 more species listing by late 1992 [101]. Forage trampling especially by ungulates, bush burning, deforestation and traditional method of honey collection from bee hives, overgrazing of pasture lands by animals, urbanization, civilization, illiteracy and over collection of medicinal plants from forests are the possible factors responsible for elimination of native plants. These factors can also hasten soil erosion [184]. Alien animals pose serious but more subtle threat to plant ecosystem. Alien birds disperse alien seeds, act as disease vectors both to plants and compete with native birds. Alien rats (*Rattus spp*) and mice (*Mus musculus*) can damage native plant species [116]. The commitments of several nations, agencies, herbariums and research institutes have increased substantially during the past three decades through interagency cooperation, and intergrated effort combining land protection, plant conservation, introduction of new species, and management against exotic species protection. This may lead to further identification of unknown plants and decrease the rate of plants extinction and rarity. Rataj and Horeman reported more than 30,000 herbal speciemens from the major botanical institutes of the world and have described about 30 new species of the genera Echinodorus, Sagitaria, Aponogeton and Cryptocoryne, the major groups of aquarium plants. Other groups of plant require a thorough revision before we can be sure of the proper names of their families, genera, species and their populations [186].

4.10 Global Climatic Change

Presently, a massive side effect of air pollution-global warming could play havoc with the world's ecosystem. Human-caused havoc increases on greenhouse gases in the atmosphere are likely to produce a global temperature rise of 1 – 3° during the next century, with an associated rise in sea level of 1 – 2 meters. It is estimated that each 1℃ rise in temperature will displace the limits of tolerance of land species some 125 km towards the poles or 150 m vertically into the mountains. Many species will not be able to redistribute themselves fast enough to keep up with the projected changes, and considerable alterations in ecosystem structure and function are likely. Many of the world's islands would be completely submerged if the more extreme projections for rise in sea level prove to be accurate-wiping out their flora and fauna [205], bearing in mind that world population is about 7.4 billion now [206].

5. CONCLUSION

There are many yet undiscovered vascular plants species and medicinal higher plants. But over harvesting, deforestation, increased human population, urbanization, farming of crop plants, animal grazing, pest rodents and the use of herbicides can cause fast destruction of vascular medicinal plants species. Special emphasis should be laid on search for medicinal plants from Asia and Africa that accommodate over 80% of human and vascular medicinal plants in the world. Frantic efforts should be made by United Nations for recovery of the plants at the verge of extinction, endanger and rarity by legislating law that would discourage destruction, over harvesting and grazing of medicinal plants. Big pharmaceutical Industries all over the world should be seriously cautioned against wanton destruction in the process of search for plants with medicinal values.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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