Flora Diversity Loss in the Bioregion of Sulawesi[1]

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ABSTRACT

Indonesia is one of the biggest biodiversity area in the world after Brazil, has about 35,000 – 42,000 species, however this data need to be confirmed. The database of the Indonesian Flora is based at the Herbarium Bogoriense and based also on the specimens which was kept since 1871. The richness of the Indonesia flora is very important for the decision makers especially how to prevent the flora diversity get loss. Sulawesi as one of the biggest island in Indonesia (182,870 km^2 with the collecation rate 23 species/ 100 km^2) has also high endemism flora species. The flora expedition to Sulawesi has been done since 1687 when Dampier visited and collected specimens from Buton. According to Steenis (1955), the total number of specimens collected from Sulawesi is 32,500 specimens, which was collected by Blume (1825 – 1827), Miquell (1855) and Koorders (1898). Keßler et al. (2002) has mentioned on this publication that there are 120 species of trees found in Sulawesi. Widjaja et al (2011) mentioned on her book "The state of Indonesian biodiversity" that Sulawesi has 6796 species, among this species it was listed that 292 species of 57 family are endemic to Sulawesi. Based on the study done since 2010, it s found that only 38Species was found in the field. When the locality of endemic species was laid on the land cover map, it was found that there are some species are no longer grow in the forest any more because the area was changed into housing area, plantation area, paddy field area or industry. The endemic species grow in specific soil characters, and certain altitude. Because of that the endemic species usually never grow in another habitat. Mapping of each endemic species will be drawn in Land cover, soil and also climate maps.

Keywords: flora diversity, loss, Sulawesi

I. INTRODUCTION

Indonesia as megabiodiversity country after Brazil, has a high flora diversity which is about 35,000 – 42,000 species (Welzen et al 2005). The position of Indonesia which laid between two tropical country Asia and Australia and two ocean Indian Ocean and Pacific Ocean make this area very unique and high endemism. Indonesia also consists of 17,500 islands which about 9 million km^2 large

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(2 million km^2 land and 7 million km^2 Ocean). Indonesia has only 1.3% of the world surface, but we have about 25% of the world Angiospermae.

Sulawesi as one of the biggest island in Indonesia (182,870 km^2 with the collecation rate 23 species/ 100 km^2) has also high endemism flora species. The flora expedition to Sulawesi has been done since 1687 when Dampier visited and collected specimens from Buton. According to Steenis (1955), the total number of specimens collected from Sulawesi is 32,500 specimens, which was collected by Blume (1825 – 1827), Miquell (1855) and Koorders (1898). Keßler et al. (2002) has mentioned on his publication that there are 120 species of trees found in Sulawesi. Widjaja et al (2011) mentioned on her book "The state of Indonesian biodiversity" that Sulawesi has 6796 species, among this species it was listed that 292 species of 57 family are endemic to Sulawesi.

In the COP (Congress of the Parties)of the Conventional Biological Diversity VIII in Brazil, one of the target in 2010 is to find the indicator of the biodiversity loss in the global, regional and national level. Whereas in the Aichi Target which has been discused in Nagoya, it is mentioned that Strategic Goal A is to address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society. LIPI as science and technology provider and knowledge-based institution, should provide data about the state of biodiversity in Indonesia as has been done on the publication of the State of Indonesian biodiversity (2011) by Widjaja et al (2011). From this data, it is expected that LIPI (c.q. Research Centre for Biology) can perform the number of endemic flora in Indonesia which is endangered or the plant which was introduced to Indonesia and become weeds and invasive alien species in Indonesia. So it is expected that data can be provided which species was lost and should be reintroduced to the original habitat, and also which species need to be conserved because of the habitat changes and make the flora in that area was been disturbed either by natural or human activities.

The purpose of this study is to record all endemic flora in Sulawesi and to monitor whether those endemic species still exist in the field by overlay the data into the land cover map which was produced by the Forestry Department. The data will also overlay with the soil and climate information of Sulawesi and the land use on conservation of that area.

II. MATERIAL AND METHODS

A list of endemic species was collected either from the references and herbarium specimens kept in the Herbarium Bogoriense (BO), L, K. From the list, the locality data is recorded and laid out on the land cover map of 2000, 2003, 2006 and 2009 which was produced by the Department of Forestry. To understand the endemism of the species, the locality data is also overlay to the natural conservation area map, soil characters and climate or rain fall classification which followed Trojer (1976). The soil and climate map were produced by the Department of Agriculture.

The locality visited to monitor whether the species is still exist or get lost, based on province where the forest left. This study was started in 2010 by monitoring the high endemism area in South Sulawesi Province (Latimojong, Lompobatang Mountains), then the following year is done in South East Sulawesi (Lamedai Nature Conservation, Mangolo tourist park, Papalia Tourist park, Rawa Aopa national park, and protected forest Sangona area), and in 2013 the monitoring program was done at

West Sulawesi (Gandangdewata protected forest) and Central Sulawesi (Lore Lindu National Park). In 2012 the monitoring program was not done because the monitoring budget was cut down by the government, so the monitoring was continued in 2013 with very short time visit due to the government regulation for the field work. So, it is frankly can be said that the monitoring program to see whether the endemic species is still existed or get lost cannot be used fully to say that those species was get lost, however, by overlaying the locality of the species to the land cover, we can predict that those species got lost due to the habitat changes.

III. RESULT AND DISCUSSION

A. Description of the study area

Geographically, the study site are located between 5°U - 7°S and 118° - 127°E. The administration of the study site involves South Sulawesi, South East Sulawesi, Central Sulawesi, West Sulawesi, however, North Sulawesi and Gorontalo Provinces has not been done.

The monitoring area for the biodiversity loss is very limited because the funding is not enough to go to every single forest. Because of that from each province, 2 areas were selected. From each locality visited, an attention was made to every area especially whether the area have swampy primary forest, swampy secondary forest, mangrove primary forest, mangrove secondary forest, dry land primary forest, dry land secondary forest and savanna. The landform of each area has drawn to see whether the endemic species has a delimitation of landform and climate such as hilly, plain, mountain, wavy, and climate type A, B, C, D with rainfall type I, II, III, IV. From the soil characteristic, the species was overlaid to soil map.

B. Endemic species of Sulawesi

Sulawesi is one of the biggest island in Indonesia also the transition area from Asean Flora with Australian Flora. Also Sulawesi is included in the central part of Malesia , is a transition zone between the Sunda and the Sahul flora, and also between Wallace line and weber line. This is one of the reason why Sulawesi has a high endemism flora. The uniqueness of the landform and rainfall, as well as the position of Sulawesi in the Wallacea line make Sulawesi possess a high endemism.

However, the endemic species in Sulawesi is get lost very easily because of the habitat changes either for housing area, plantation, road establishment or even illegal logging. Two global environmental "problems": currently attracting almost obsessive popular interest on climate change and biodiversity loss. This study is concerned to the problem of biodiversity loss, later on it is expected that this problem can also bring the ecological consequences of biodiversity loss. Then the biodiversity loss can be evaluated to satisfied of human needs which make direct value or private value and also to make indirect value to the society or its call social value Perrings et al. (1997).Van Welzen et al (2005) mentioned that the flora of Sulawesi consist of 1065 species with the endemic flora 144 species and 921 for non endemic species, and it is expected that the endemic species will increase till 265 species. Van Welzen & Silk (2009) mentioned that Sulawesi which is part of Wallacea consists of 1169 species, with 160 species endemic (14% endemics) from the area with the size 182,870 km^2 or 6% of the Malesian region.

Based on the data collected from the references and 675 specimen Herbariium, it is recorded that there are listed that 292 species of 57 family are endemic to Sulawesi as shown on Table 1.

No	Family	Jenis
1	Acanthaceae	Strobilanthes calcicola J.R.I Wood & J. R. Benn.
2	Apiaceae	Trachymene acrotricha Buwalda
3		Trachymene celebica Hemsl.
4		Trachymene erodioides Buwalda
5		Trachymene sarasinorum (Warb. ex H.Wolff) Buwalda
6	Apocynaceae	Alyxia celebica D.J.Middleton
7		Alyxia globosa D.J.Middleton
8		Alyxia kabaenae Markgr.
9		Alyxia kendarica Markgr.
10		Alyxia lackii D.J.Middleton
11		Alyxia uniflora D.J.Middleton
12		Kibatalia wigmanii (Koord.) Merr.
13		Ochrosia acuminata Trimen ex Valeton
14		Ochrosia basistamina Hendrian
15		Rauvolfia kamarora Hendrian
16	Araceae	Alocasia balgooy A. Hay
17		Alocasia megawatiae Yuzammi & A.Hay
18		Alocasia suhirmaniana Yuzammi & A. Hay
19		Amorphophallus plicatus Bok & Lam.
20		Homalomena vittariifolia
21		Schismatoglottis inculta
22	Araliaceae	Arthrophyllum kjellbergii Philipson
23		Boerlagiodendron celebicum Lam.
24		Osmoxylon celebicum Philipson
25		Osmoxylon masarangense Philipson
26		Osmoxylon talaudense Philipson
27		Osmoxylon teysmannii (Boerl.) Philipson
28	Arecaceae	Areca oxycarpa Miq.,
29		Calamus aff inops Becc ex Heyne
30		Calamus ahlidurii Fernando
31		Calamus boniensis Becc ex Heyne
32		Calamus boniensis Beccari ex Heyne
33		Calamus didymocarpus Warb.
34		Calamus inops Becc ex Heyne
35		Calamus kandariensis Beccari
36		Calamus kjelbergii Furt.

No	Family	Jenis
37		Calamus koordersianus Becc
38		Calamus leiocaulis Beccari ex Heyne
39		Calamus leptostachys Becc ex Heyne
40		Calamus lorelinduensis JP Mogea & Rustiami
41		Calamus macrosphaerion Becc.
42		Calamus minahassae Warb ex Becc
43		Calamus obscurus Becc.
44		Calamus ornatus var. ornatus Blume
45		Calamus orthostachyus Furt.
46		Calamus pachystachys Warb ex Becc.
47		Calamus paucijugus Becc ex Heyne.
48		Calamus perpendiculus Rustiami
49		Calamus plicatus Blume
50		Calamus pseudomollis Becc
51		Calamus rosetus Rustiami
52		Calamus scleracanthus Becc ex Heyne
53		Calamus siphonospathus var. dransfieldii Baja Lapis
54		Calamus suaveolens W. J. Baker J. Dransf
55		Calamus symphysipus Martius
56		Calamus zollingeri Becc.
57		Daemonorops lamprolepis Becc.
58		Daemonorops macroptera (Miq.) Becc.
59		Daemonorops mogeana Rustiani
60		Daemonorops riedeliana Becc.
61		Daemonorops robusta Warb.
63		Daemonorops sarasinorum Warb.
64		Daemonorops schlechterii
65		Daemonorops takanensis Rustami
66		Granophyllum microspadix Burret
67		Gromophyllum kjelbergii Burret
68		Gromophyllum sarasinorum Burret
69		Gromophyllum selebicum (Becc.) Becc.
70		Korthalsia celebica Becc.
71		Pigafetta elata Becc.
72		Pinanga caesia Blume
73		Pinanga celebica Scheff.
74		Pinanga cf celebica
75		Pinanga kjellbergii
76		Pinanga macrorachis Burret
77		Pinanga macrostachya

No	Family	Jenis
78		Vaccinium paludicolum Sleum.
79	Aristolochiaceae	Thottea celebica Ding Hou
80	Begoniaceae	Begonia aptera Bl.
81		Begonia aptera subsp hirtissima Girmansyah & Dc. Thomas
82		Begonia bantamensis Hemsl val. Aff
83		Begonia capituliformis
84		Begonia comestibilis DC Thomas & Ardi
85		Begonia cuneatifolia Irmsch.
86		Begonia didyma Dc. Thoms et Ardi
87		Begonia flacca Irmsch
88		Begonia gemella Warb ex L. B. Sm & Wassh.
89		Begonia guttapila D.C.Thomas & Ardi,
90		Begonia hekensis D. C. Thoms.
91		Begonia heteroclinis
92		Begonia hirtella Link.
93		Begonia hispidissima Zipal ex Koorders.
94		Begonia insueta DC Thomas & Ardi
95		Begonia koordersii Warb ex L. B. Sm
96		Begonia lasioura DC Thomas & Ardi
97		Begonia longifolia Blume Complex.
98		Begonia masarangensis Irmsch.
99		Begonia mekongensis Girmansyah & Wiriadinata
100		Begonia nobmanniae DC Thomas & Ardi
101		Begonia ozotothrix Dc. Thomas.
102		Begonia prionota DC Thomas & Ardi
103		Begonia pseudolateralis
104		Begonia rachmati Tebbitt.
105		Begonia rantemarioensis DC Thomas & Ardi
106		Begonia sanguineopilosa DC Thomas & Ardi
107		Begonia siccacaudata J.Door.
108		Begonia torajana DC Thomas & Ardi
109		Begonia varipeltata De Thomas.
110		Begonia vermeulenii DC Thomas
111		Begonia watuwilensis Girmansyah
112	Boraginaceae	Cordia aspera G.Forst
113	Burmanniaceae	Gymnosiphon minahassae Schltr.
114	Burseraceae	Canarium acutifolium (DC.) Merr
115		Canarium trigonum H.J.Lam

No	Family	Jenis
116	Celastraceae	Euonymus impressus Blakelock
117		Salacia blepharophora Ding Hou
118		Salacia intermedia Ding Hou
119	Combretaceae	Terminalia celebica Exell
120		Terminalia kjellbergii Exell
121		Terminalia supitiana Koord.
122	Convolvulaceae	Argyreia celebica Ooststr.
123		Argyreia cinerea Ooststr.
124		Ipomoea stibaropoda Ooststr.
125	Cunoniaceae	Weinmannia celebica Koord.
126		Weinmannia coodei H.C.Hopkins
127		Weinmannia descombesiana Bernardi
128		Weinmannia devogelii H.C.Hopkins
129	Cyperaceae	Fimbristylis celebica Ohwi
130		Scirpus subcapitatus Thwaites ssp. celebicus Kern
131	Dichapetalaceae	Dichapetalum steenisii Leenh.
132	Dilleniaceae	Dillenia celebica Hoogl.
133		Dillenia ochreata (Miq.) Teijsm. & Binn.
134		Dillenia serrata Thunb.
135		Dillenia talaudensis Hoogl.
136	Dioscoreaceae	Dioscorea kjellbergii R.Knuth
137		Dioscorea sarasinii Uline ex R.Knuth
138		Dioscorea sexrimata Burk.
139		Dioscorea vanvuurenii Prain & Burk.
140		Dioscorea warburgiana Uline ex Koord.
141	Dipterocarpaceae	Hopea celebica Burck
142	Ebenaceae	Diospyros celebica Bakh.
143	Ericaceae	Diplycosia aperta J.J.Sm.
144		Diplycosia caryophylloides J.J.Sm.
145		Diplycosia caryophylloides J.J.Sm. var. longipes Sleum.
146		Diplycosia celebensis J.J.Sm.
147		Diplycosia crassiramea Sleum.
148		Diplycosia haemantha Sleum.
149		Diplycosia kjellbergii J.J.Sm.
150		Diplycosia minutiflora Sleum.
151		Diplycosia rubidiflora J.J.Sm.
152		Diplycosia sagittanthera J.J.Sm.
153		Diplycosia stenophylla Sleum.

No	Family	Jenis
154		Diplycosia undata J.J.Sm.
155		Gaultheria celebica J.J.Sm. var. petiolata J.J.Sm.
156		Gaultheria viridiflora Sleum.
157		Rhododendron arenicolum Sleum.
158		Rhododendron bloembergenii Sleum.
159		Rhododendron celebicum (Blume) DC.
160		Rhododendron eymae Sleum.
161		Rhododendron impositum J.J.Sm.
162		Rhododendron lagunculicarpum J.J.Sm.
163		Rhododendron leptobrachion Sleum.
164		Rhododendron lindaueanum Koord.
165		Rhododendron lompohense J.J.Sm.
166		Rhododendron nanophyton Sleum.
167		Rhododendron nanophyton Sleum. var. petrophilum Sleum.
168		Rhododendron poremense J.J.Sm.
169		Rhododendron pseudobuxifolium Sleum.
170		Rhododendron psilanthum Sleum.
171		Rhododendron pudorinum Sleum.
172		Rhododendron quadrasianum Vidal var. selebicum J.J.Sm.
173		Rhododendron radians J.J.Sm. var. minahassae Sleum.
174		Rhododendron rhodopus Sleum.
175		Rhododendron scarlatinum Sleum.
176		Rhododendron vanvuurenii J.J.Sm.
177		Vaccinium antrocelebicum var vicius Sleum
178		Vaccinium aucupis Sleum.
179		Vaccinium centrocelebicum Sleum.
180		Vaccinium centrocelebicum Sleum. var. maius Sleum.
181		Vaccinium cuneifolium (Blume) Miq.
182		Vaccinium dubiosum J.J.Sm.
183		Vaccinium henrici Sleum.
184		Vaccinium kjellbergii J.J.Sm.
185		Vaccinium latissimum J.J.Sm.
186		Vaccinium paludicolum Sleum.
187		Vaccinium pilosilobum J.J.Sm.
188		Vaccinium tomicipes J.J.Sm.
189		Vaccinium warburgii Sleum.
190	Fabaceae	Kallapia celebica Kosterm.
191	Flacourtiaceae	Homalium celebicum Koord.
192	Gesneriaceae	Aeschynanthus sojolianus Mendum & L.E.R.Galloway
193		Aeschynanthus celebicus Koord.

No	Family	Jenis
194		Aeschynanthus citrinus Mendum & S. Scott.
195		Agalmyla bicolor Hilliard & B.L.Burtt
196		Agalmyla exannulata Hilliard & B.L.Burtt
197		Agalmyla hilliardiae D.J.Middleton & S.Scott
198		Agalmyla immersinervia Hilliard
199		Agalmyla paucipilosa Hilliard & B.L.Burtt
200		Agalmyla pulcherrima Hilliard & B.L.Burtt
201		Agalmyla remotidentata Hilliard & B.L.Burtt
202		Agalmyla scabriflora Hilliard & B.L.Burtt
203		Agalmyla sojoliana Hilliard & B.L.Burtt
204		Agalmyla torajiana Hilliard & B.L.Burtt
205		Agalmyla vogelii Hilliard & B.L.Burtt
206		Cyrtandra bruteliana Koord.
207		Cyrtandra coccinea Blume var. celebica (Blume) C.B.Clarke
208		Cyrtandra cuneata Blume
209		Cyrtandra engleri Koord.
210		Cyrtandra fasciata H.J.Atkins
211		Cyrtandra gorontaloensis H.J.Atkins
212		Cyrtandra luteiflora H.J.Atkins
213		Cyrtandra polyneura (C.B.Clarke) B.L.Burtt
214		Cyrtandra purpurea H.J.Atkins
215		Cyrtandra serratifolia H.J.Atkins
216		Cyrtandra tenuicarpa H.J.Atkins
217	Gnetaceae	Gnetum gnemon L.
218	Icacinaceae	Gomphandra velutina Sleum.
219		Stemonurus celebicus Valeton ex Koord.
220	Leeaceae	Leea smithii Koord.
221	Loganiaceae	Fagraea tacapala Leenh.
222		Fagraea truncata Blume
223	Loranthaceae	Amyema irrubescens Barlow
224		Decaisnina celebica (Hemsl.) Barlow
225	Magnoliaceae	Magnolia phaulanta Dandy ex Noot.
226	Malphigiaceae	Aspidopterys celebensis Arenes
227	Malvaceae	Hibiscus teijsmannii Borss.Waalk.
228		Hibiscus tiliaceus L.
229	Melastomataceae	Astronia gracilis Bakh.f.
230		Astronia stapfii Koord.
231		Medinilla celebica Blume
232		Medinilla mucronata Koord.
233		Melastoma horridum Bakh.f.

No	Family	Jenis
234		Memecylon celebicum Bakh.f.
235		Memecylon crassifoilium Bakh.f.
236	Meliaceae	Chisocheton celebicus Koord.
237		Chisocheton warburgii Harms.
238	Menispermaceae	Tinospora celebica Diels
239	Mimosaceae	Archidendron crateradenum (Kosterm.) Nielsen
240		Archidendron minahassae (Koord.) Nielsen
241		Archidendron tjendana (Kosterm.) Nielsen
242	Moraceae	Ficus celebensis Corner
243		Ficus decipiens Reinw. ex Blume
244		Ficus geocarpa Teijsm. & Binn.
245		Ficus kofmaniae C.C.Berg
246		Ficus matanoensis C.C.Berg
247		Ficus minahasae Miq.
248		Ficus remifolia Corner ex C.C.Berg
249		Ficus submontana C.C.Berg
250		Ficus tonsa Miq.
251	Musaceae	Musa celebica Warb.
252	Myristicaceae	Gymnacranthera maliliensis R.T.A.Schouten
253		Horsfieldia coriacea W.J.de Wilde
254		Horsfieldia talaudensis W.J.de Wilde
255		Knema celebica W.J.de Wilde
256		Knema matanensis W.J.de Wilde
257		Myristica devogelii W.J.de Wilde
258		Myristica impressinervia J.Sinclair
259		Myristica koordersii Warb.
260		Myristica ultrabasica W.J.de Wilde
261	Nepenthaceae	Nepenthes glabratus J.R.Turnbull & A.T.Middleton
262		Nepenthes tomoriana Danser
263	Orchidaceae	Coelogyne multiflora Schltr.
264		Phalaenopsis celebensis Sweet
265		Phalaenopsis venosa PS Shim & Fowlie
266		Vanda Celebica J.J. Sm.
267		Vanda devoogtii J.J.Sm.
268	Oxalidaceae	Sarcotheca celebica Veldkamp
269	Piperaceae	Piper caninum Blume
270	Poaceae	Racemobambos celebica
271	Polygalaceae	Xanthophyllum celebicum Meijden
272	Proteaceae	Grevillea elbertii Sleum.
273		Helicia celebica Sleum.

No	Family	Jenis
274		Helicia kjellbergii Sleum.
275		Helicia kjellbergii Sleum. var. calva Sleum.
276		Helicia teysmanniana Sleum.
277	Rubiaceae	Psychotria celebica Miq.
278		Timonius stipulosus Boerl.
279	Sapindaceae	Cupaniopsis celebica Adema
280		Cupaniopsis strigosa Adema
281		Guioa hirsuta Welzen
282		Lepisanthes falcata (Radlk.) Leenh. ssp. celebica (Radlk.) Leenh.
283		Trigonachras celebensis Leenh.
284	Sapotaceae	Manilkara fasciculata (Warb.) Mull. Arg.
285	Schisandraceae	Kadsura celebica A.C.Sm.
286	Symplocaceae	Symplocos ambangensis Noot.
287		Symplocos maliliensis Noot.
288	Taccaceae	Tacca celebica Koord.
289	Thymelaeaceae	Gyrinops decipiens Ding Hou
290	Tiliaceae	Colona celebica (Blume) Burr.
291	Verbenaceae	Clerodendrum lanuginosum Blume
292	Viscaceae	Viscum exile Barlow

From the above table it can be seen that Arecacee, Ericaceae, Begoniaceae, Gesneriaceae have very high endemism in Sulawesi, beside that Apocynaceae, Myristicaceae and Moraceae are has medium diversity in Sulawesi. Because of that it can be said that Sulawesi is the home of Arecaceae, Ericaceae, Gesneriaceae and Begoniaceae. According to van Welzen & Silk (2009), Ericaceae is a family found at a higher atitudes, and possess many endemics species (716 out of 732 species recorded in Flora Malesiana). The Ericaceae are well represented on the Sunda Shelf, are almost absent in Wallaceae, but are extremely species rich with several genera on the Sahul Shelf. This statement is different than the reality where we have the highest number of endemic species of Ericaceae in Sulawesi (Wallacea). One of the reasonon the high endemism is the soil characters of this area is very unique compare to other area of Indonesian archipelago. When the inventory of the endemic flora is finalized, and the data is overlay to land cover, the data of the endemic flora which may get lost can be drawn easily. From example on Arecaceae, Calamus is a genus of rattan has the highest demand in the market, but this also included in the genus which has a high diversity, but also risk due to overload harvesting. Therefore, the species is very risk in the future and get lost easily. One of the effort to make the species do not get lost is by reintroducing the species in the same locality. When the species has not lost, a collecting seedling need to be done and germinating in the Forestry Department to be reintroduced to the original locality when the seedling was collected.

Beside providing data on the endemic species, a monitoring to the localities have been done since 2010, but the monitoring result is not always positive, because the locality has been changed, or the area visited is not the same when collection was made. The latest reason was there is no

accurate information on the attitude, or coordinate where the specimens were collected. When the specimen grow abundantly, those specimens are still found. After 4 years monitoring, 38 species of 292 species still exist in the field (Table 2). From the table below it can be seen that the highest number of specimens seen in the field is family Ericaceae. One of the reason for this, because the monitoring has been done in the high mountainous area such as Latimojong and Lompobatang where the monitoring has been done.Another family is Gesneriaceae, Apiaceae and Poaceae also found in the highland, whereas Araceae found in the lowland.

Table 2. Species found in the field.

No.	Family	Species	Found in the field
1	Apiaceae	Trachymene acrotricha Buwalda	1
2	Apiaceae	Trachymene celebica Hemsl.	1
3	Apiaceae	Trachymene erodioides Buwalda	1
4	Apocynaceae	Alyxia kabaenae Markgr.	1
5	Araceae	Alocasia balgooy A. Hay	1
6	Araceae	Alocasia suhirmaniana Yuzammi & A. Hay	1
7	Araliaceae	Osmoxylon masarangense Philipson	1
8	Cunoniaceae	Weinmannia descombesiana Bernardi	1
9	Dilleniaceae	Dillenia serrata Thunb.	1
10	Ericaceae	Diplycosia celebensis J.J.Sm.	1
11	Ericaceae	Diplycosia crassiramea Sleum.	1
12	Ericaceae	Diplycosia rubidiflora J.J.Sm.	1
13	Ericaceae	Diplycosia undata J.J.Sm.	1
14	Ericaceae	Gaultheria celebica J.J.Sm. var. petiolata J.J.Sm.	1
15	Ericaceae	Gaultheria viridiflora Sleum.	1
16	Ericaceae	Rhododendron arenicolum Sleum.	1
17	Ericaceae	Rhododendron celebicum (Blume) DC.	1
18	Ericaceae	Rhododendron eymae Sleum.	1
19	Ericaceae	Rhododendron lagunculicarpum J.J.Sm.	1
20	Ericaceae	Rhododendron lindaueanum Koord. var. bantaengense J.J.Sm.	1
21	Ericaceae	Rhododendron nanophyton Sleum.	1
22	Ericaceae	Rhododendron psilanthum Sleum.	1
23	Ericaceae	Rhododendron quadrasianum Vidal var. celebicum J.J.Sm.	1
24	Ericaceae	Rhododendron rhodopus Sleum.	1
25	Ericaceae	Vaccinium centrocelebicum Sleum.	1
26	Ericaceae	Vaccinium cuneifolium (Blume) Miq.	1
27	Ericaceae	Vaccinium latissimum J.J.Sm.	1
28	Fabaceae	Kallapia celebica	1
29	Gesneriaceae	Agalmyla scabriflora Hilliard & B.L.Burtt	1

No.	Family	Species	Found in the field
30	Gesneriaceae	Agalmyla torajiana Hilliard & B.L.Burtt	1
31	Loganiaceae	Fagraea tacapala Leenh.	1
32	Loranthaceae	Decaisnina celebica (Hemsl.) Barlow	1
33	Melastomataceae	Melastoma horridum Bakh.f.	1
34	Musaceae	Musa celebica Warb.	1
35	Musaceae	Musa sp. (jantung pendulus merah)	1
36	Piperaceae	Piper caninum Blume	1
37	Poaceae	Racemobambos celebica	1
38	Sapindaceae	Cupaniopsis celebica Adema	1
			38

The unseen specimens were not means that they get lost already, but an overlay with the land cover forest 2000, 2003, 2006 and 2009 is necessary as shown on the discussion below.

Distribution pattern of the endemic flora based on the land cover and land use agreement

Based on the endemic flora data, it can be seen that most endemic species like to grow in the primary dry land forest. However, since 2000 – 2009 (Figure 1 – 4), it showed that the endemic species found in the area and which not changes significantly, except in South Sulawesi. Most of the endemic species in South Sulawesi was found outside of the forest. Because of that it is more difficult to find those species because the habitat has changed from the original vegetation become housing, plantation or infrastructure.

On the figure 2, it can be seen that the forest area has been decreased due to increase the plantation area, the settlement, mining and dryland farming. This data can also be seen on table 3.

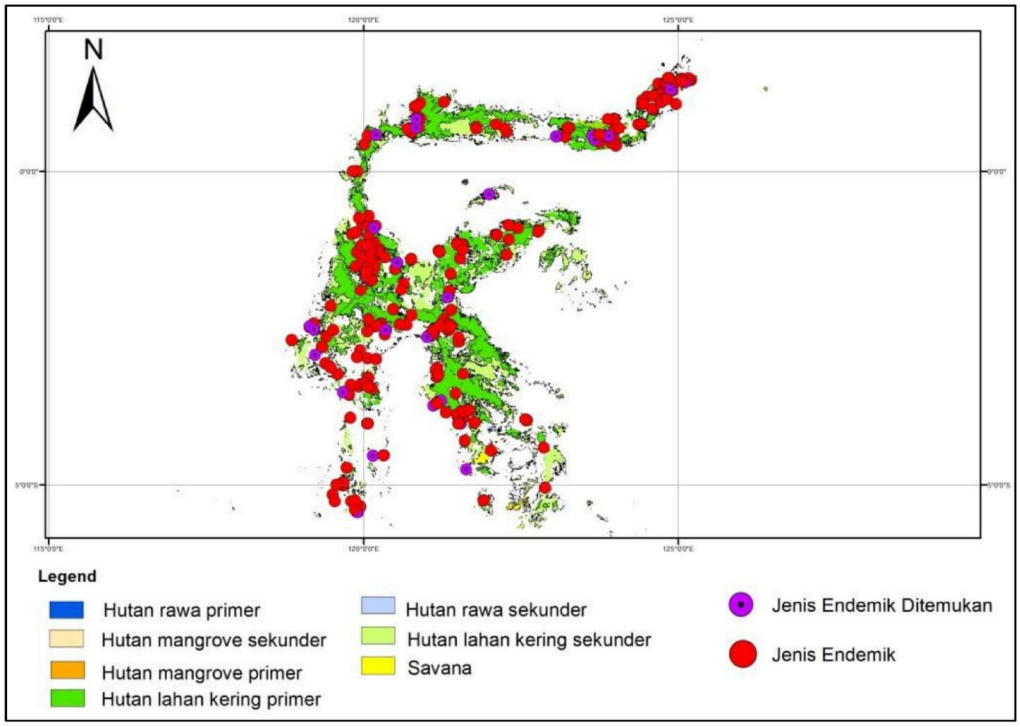

Figure 1. Diversity of endemic plants with land cover in year 2000

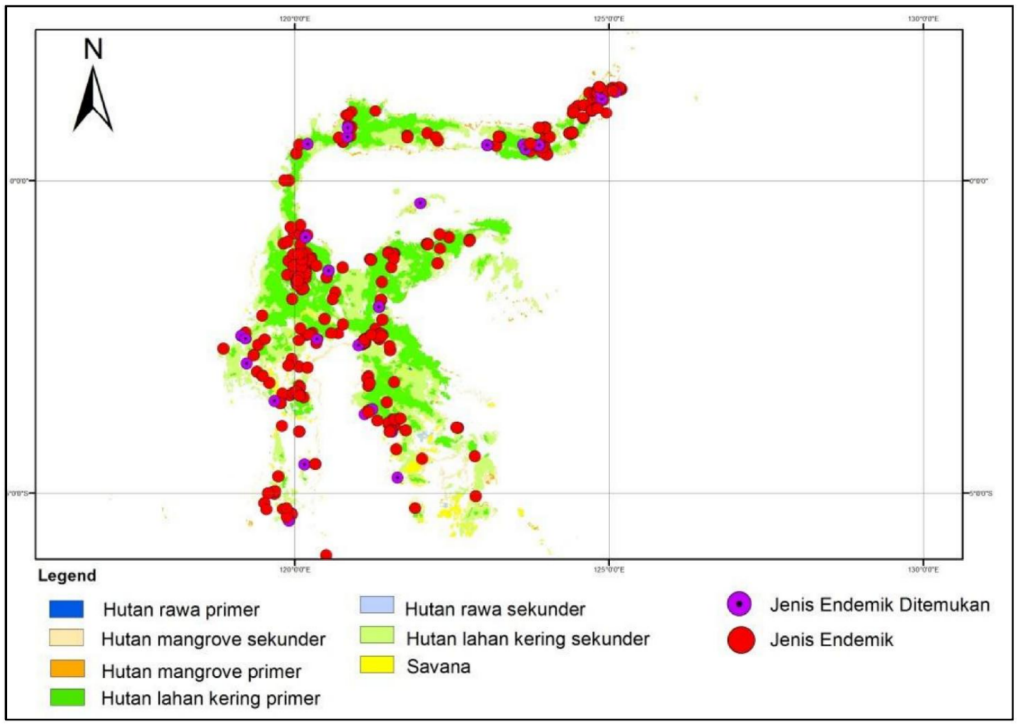

Figure 2. Diversity of endemic plants with Land Cover in Year 200

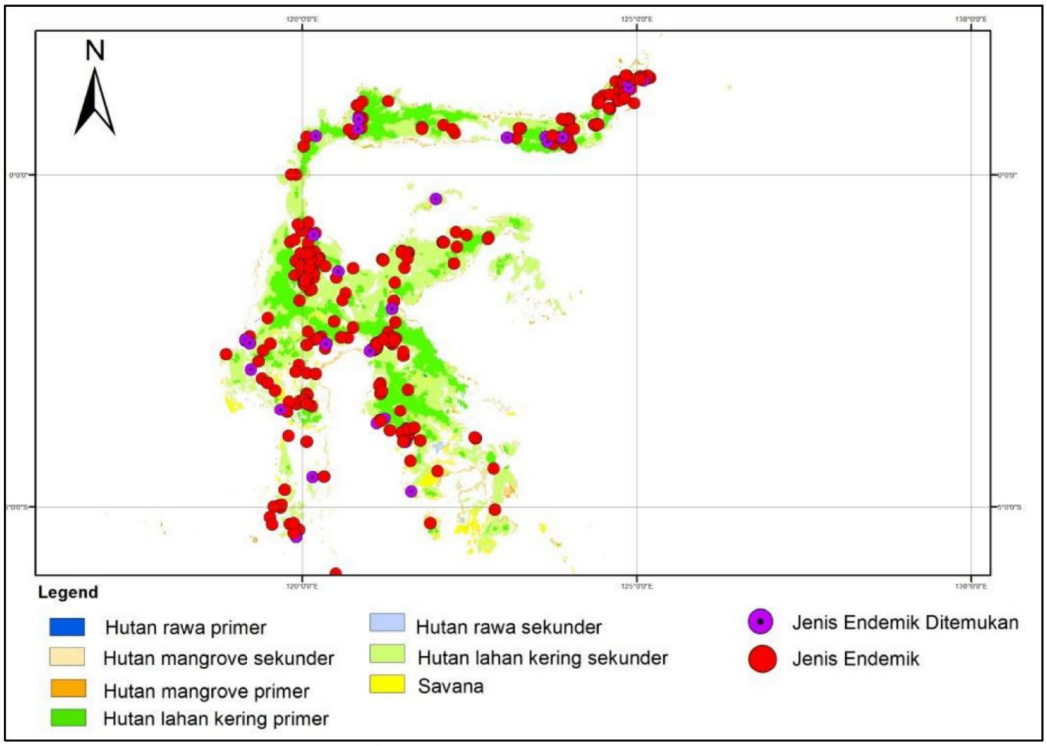

Figure 3. Diversity of endemic plants with Land Cover in Year 2006

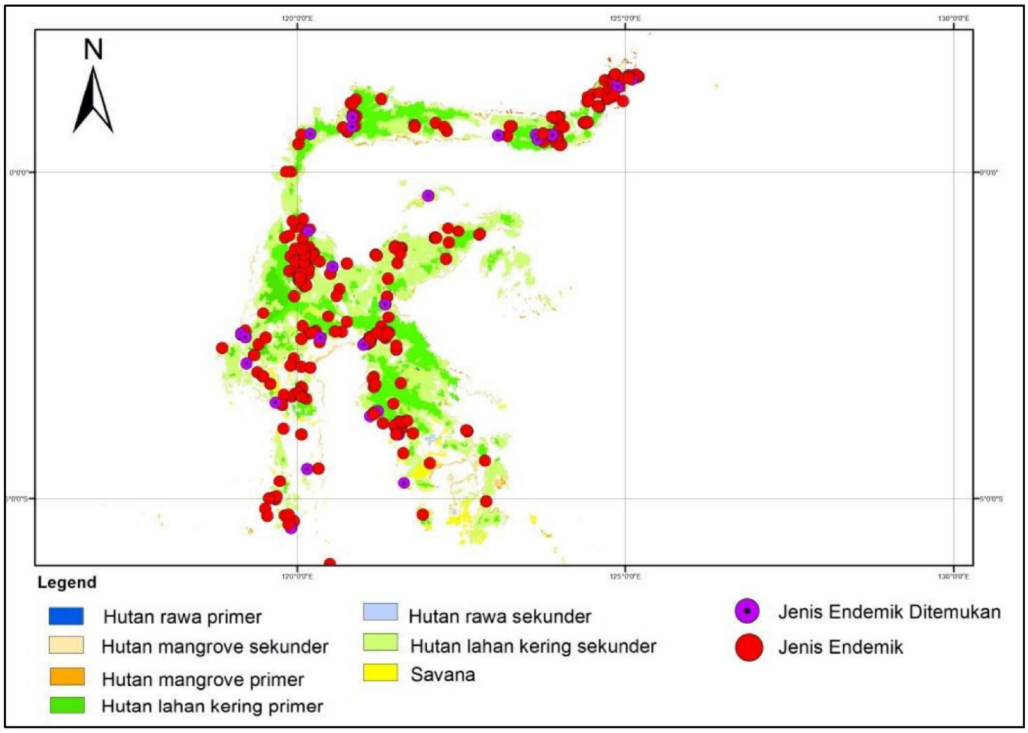

Figure 4. Diversity of endemic plants with Land Cover in Year 2009

In year 2000, most of Sulawesi has dominated by dry primary forest (Fig. 1), then the situation was changed every year as seen on table 3. Therefore in 2009, the endemic flora mostly found not in the forest area, because the primary dryland forest has decreased rapidly in 2009, on the other hand the secondary dryland forest, plantation, settlement, mining, dryland farming with shrub is increasing rapidly (Fig 4). The reduced rate of forest is correlated to the increasing of the housing area (settlement), plantation (agriculture), mining, transmigration area and also savanna. If no one pay attention to the degraded land, then the loss of endemic flora will go faster.

Table 3. Area of changes for each land cover in year 2000 until 2009

No.	Type of Land Cover	Area (Ha)			
		Year 2000	Year 2003	Year 2006	Year 2009
1	Swampy Shrub	33938,60	31380,95	33028,75	33649,92
2	Primary Dryland Forest	5830259,37	5608153,86	3953460,95	3893454,89
3	Secondary Dryland Forest	4573432,68	4656505,16	6030392,60	6033794,08
4	Primary Mangrove Forest	54688,06	51665,61	47581,30	45181,73
5	Secondary Mangrove Forest	150328,28	151312,40	150263,43	149864,08
6	Primary Swampy Forest	755,72	755,72	755,72	755,72
7	Secondary Swampy Forest	33216,40	33022,69	31503,90	31230,66
8	Production Forest	16746,83	16746,83	17027,15	16730,95
9	Seaport / Airport	816,74	816,74	1292,02	1292,02
10	Plantation	244263,78	245927,09	246760,97	254018,15
11	Settlement	103086,65	103320,39	104561,00	114339,62
12	Mining	12995,88	13302,19	13667,57	14174,80
13	Dryland Farming	865847,78	878106,53	932812,21	930556,19
14	Dryland Farming with Shrub	3565357,90	3672793,03	3728173,24	3754065,76
15	Swamp	8996,09	8646,57	9004,74	9157,46
16	Savanna	306142,64	306261,08	306213,04	334736,13
17	Sawah	935869,11	934977,44	938722,81	958074,54
18	Shrub	1466336,93	1484543,29	1641341,12	1636232,05
19	Fishpond	149250,32	154583,13	159923,37	162951,82
20	Clearing Land	118741,22	118483,55	125134,08	97597,37
21	Transmigration Area	12525,12	12525,12	12525,12	12731,86
22	Water	199617,41	199933,10	199617,41	199172,67
	Total	**18683213,51**	**18683762,49**	**18683762,49**	**18683762,49**

Except for the land cover changes, another factor which may occurred is when monitoring has been done, the endemic flora was collected before, not from the conservation area. So it is difficult to map them if the locality belong to customary land, or private land which may get change already. It is expected the flora endemic from the nature conservation area is still exist.

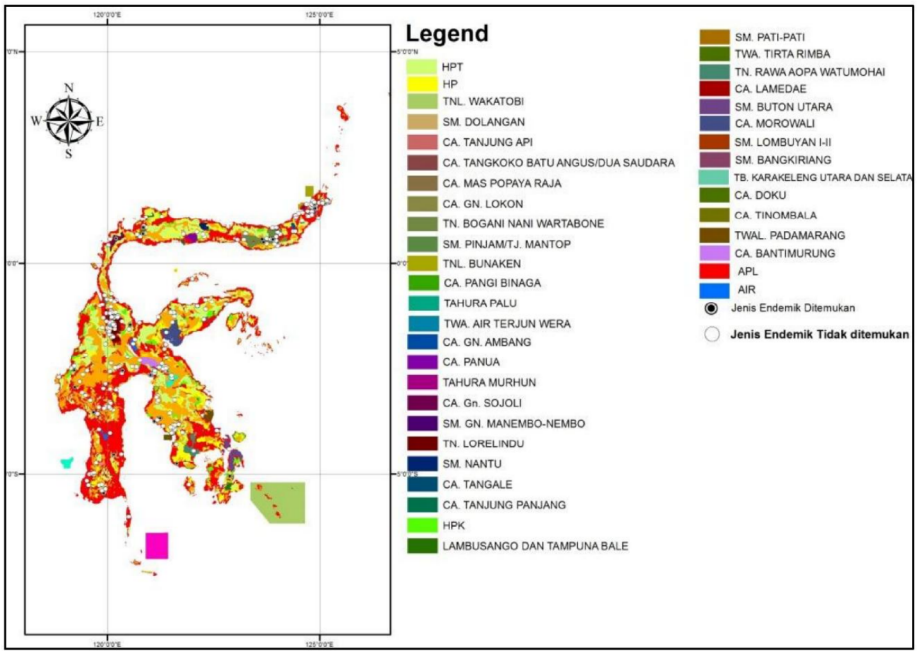

Figure 5. Diversity of endemic plants with forest land use agreement

Distribution of the Endemic flora based on their landform and rainfall

On the figure 6, it can be seen that most of the endemic species like to grow in the sediment, volcanic and plutonic. However, several species can be found in different landform characters. The variation of landform can make the species adaptable,or very specific on the habitat for each species. By adapting to the habitat, distribution rate of each species may adaptable and regenerated easily, but most of the endemic species are not adaptable and difficult to regenerate because of that the endemic species grow on the very specific habitat.

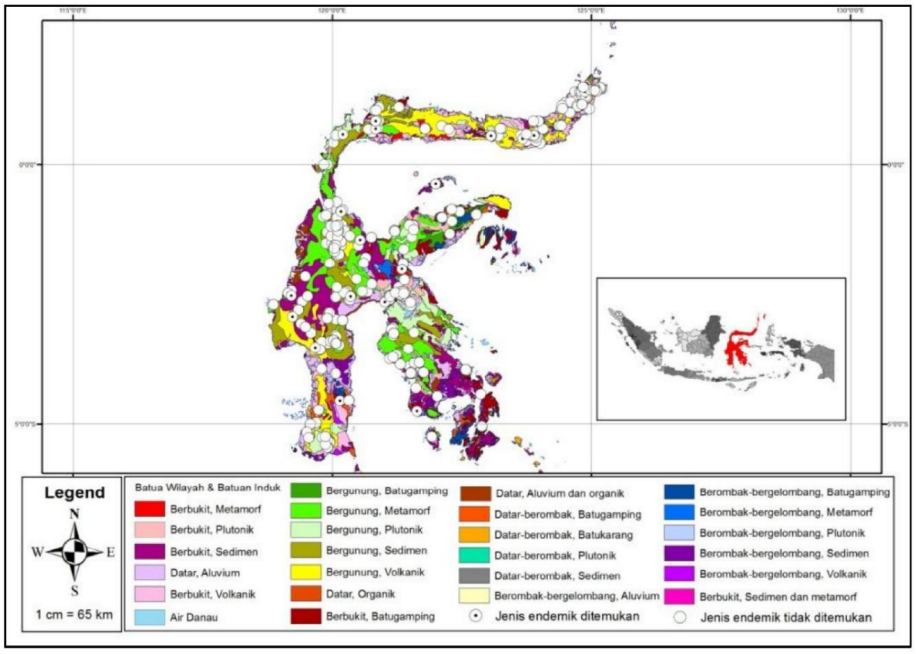

Figure 6. Diversity of Endemic species with Type of Landform

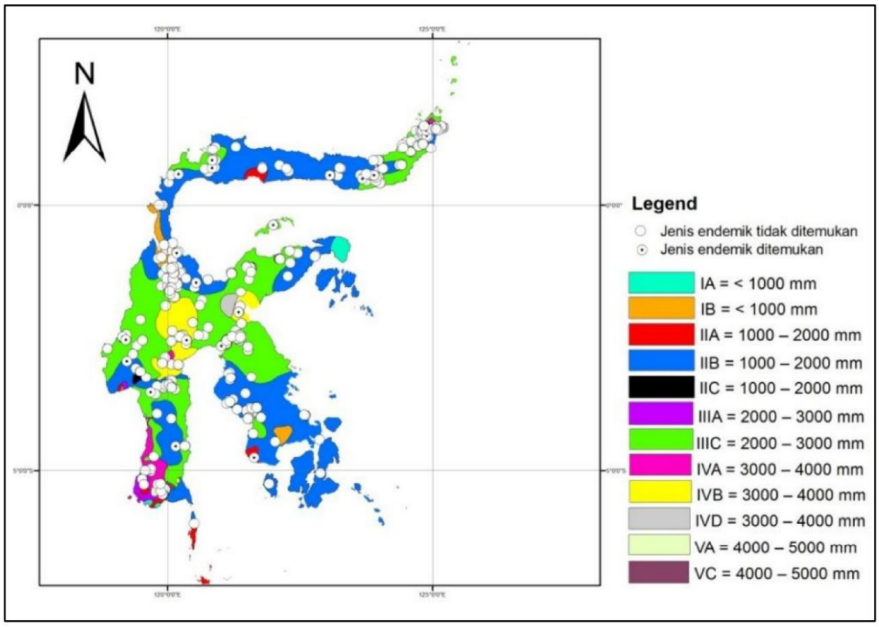

Figure 7. Diversity of Endemic speccies with Type of Rainfall

On the Figure 7, the rainfall sequences types rainfall per year show that the endemic species mostly grow in the rainfall type II B where the rainfall has rain between 1000 – 2000 mm/year with multiple wave. The type II B rainfall can be included in the dry climate. Also the endemic species like to grow in the type III C where the rainfall occurred between 2000 – 3000 mm/year with double wave

rainfall. Some species in the Sourh Sulawesi grow in rainfall type IVA where the rainfall has rain between 3000 – 4000 mm/year with the simple wave and the lowest rainfall found at July – August. The latest type of rainfall is included in the wet climate. When the endemic species is correlated to the habitat landform, it is shown that the endemic species in the north and central of Sulawesi generally grow in the sediment landform. In the south of Sulawesi, this endemic species is adaptable with the rainfall type IIIA (wet climate) and IVA (Wet Climate) in the volcanic landform. In the South East Sulawesi, the area is dominated by rainfall type IIB (dry climate) with metamorph landform. The adaptable species on this condition can make the flora in this area became endemic.

IV. CONCLUSION

From this study it can be concluded that the endemic species of Sulawesi is 292 species (out of 6796 species, 4.3%) of 57 family, among this 38 species has been collected in the field. Due to a high changes on habitat destruction, it is expectedthe endemic species can be to be used in reintroduction at the original locality. An intensive field work to find those endemic species is very important to prevent biodiversity loss. If it is possible a protection on the habitat changes should be done to prevent more biodiversity get loss. Further data on the endemic species need to be collected, although Widjaja et al. (2011) has mentioned that there are 6796 species found in Sulawesi.

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