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Diversity of vegetation around the springs to support water resource conservation in belu, East Nusa Tenggara, Indonesia

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Abstract

The research was conducted in catchment area of Lahurus, Wetihu, Wewai and Mauhalek, Lasiolat District of Belu Regency, East Nusa Tenggara. The purpose of this research was to find out species composition and stratification of vegetation in springs to support water resource conservation. Vegetation sampling was conducted using quadrate method. Data were collected for further analysis in descriptively-quantitatively way using the important value index. The results showed there were 71 species and 1,910 individuals belong to 30 families. Calculation results show the presence of a dominant species based on the highest importance value index found in the study area (>50%). Species found was *Caryota mitis*, *Spathodea campanulata*, *Intsia bijuga*, *Aglaia argentea*, *Alstonia scholaris*, *Mangifera minor*, *Terminalia catappa*, *Arenga pinnata* and *Ficus* sp. From quantitative analysis it showed that dominant index value there were no species dominating over other species or community structure was stable because c = 0. The species diversity index of tree phase in study site categorized low to moderate with value 0.94 to 1.12.The results calculation of community similarity index on tree phase in study site as follows; Lahurus-Wetihu obtained value 59.46%, Wetihu-Wewai 30.30 and Wewai-Mauhalek 46.67. Stratification of vegetation in the study area was complete from A stratum to E stratum. Vegetation was found in generally a local species that can growing and develop optimally in the spring. Species found was *Spathodea campanulata*, *Intsia bijuga*, *Mangifera minor*, *Dendrocalamus* sp., *Zysigium* sp, and *Ficus* sp. Species found was considered to have a good value for soil conservation and water conservation because it has a compact establishment canopy and complex root architecture.

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Introduction

In the case of forest ecosystems occurs close relationship between plants and the environment. This relationship is shown by the variation in species composition and structure vegetation. The formation of the pattern of diversity and vegetation structure is a dynamic process and is closely related to environmental conditions, biotic and abiotic. Forest composition and structure of vegetation types that vary able to provide environmental benefits for human life, such as storage sheds water and the absorption of rainwater and dew which will eventually flow into the rivers in the middle of the forest which has a springs (Soerianegara and Indrawan, 2008).

Springs is the main water source for community Belu Regency to needs of consumption, household, office, farm irrigation, power generation and other environmental activities. Some of main water source that has the potential discharge and used it continuously is Lahurus water springs, Wetihu spring, Wewai spring and Mauhalek spring in the highlands Lasiolat district. The existence of those springs is influenced by vegetation around. Vegetation around the springs has an important role to increase the supply of groundwater and springs. However, due to the high rate of deforestation contributes to discharge water source, the water supply for the community continues to decline.

The role and benefit of the springs is so important in supporting the activities of local community and Belu Regency in whole. This condition becomes serious situation; if there is no conservation effort conducting in the catchment area. The amount of water sources that do not function will increase (*critical springs*) and it will affect the development of Atambua as the border between Indonesia and Timor Leste. In addition, study about vegetations around the springs is few because a lack of understanding about ecological value of vegetation and relationship with conservation of springs. Research on diversity of vegetation around the spring is expected to help gather information and determine level diversity of plant species that can be used as a basis for conservation efforts of the springs. Therefore, research on diversity of vegetations around the springs as source water conservation is very important in this area. The purpose of this study is to determine species composition and structure of vegetations around the springs as source water conservation efforts in Lasiolat District, Belu Regency.

Materials and methods

Study Site

Research sites located in Lasiolat District, Belu regency of East Nusa Tenggara.Lahurus springs at Fatulotu village, Wetihu springs at Baudaok village, Wewai springs at Lakanmau village and Mauhalek springs at Raiulun village (Fig. 1). Implementation of research was from April to July 2014. The equipment used in this study consisted of compass, GPS, digital cameras, hagameter, machete, meter roll, paper for labeling and tally sheet whereas materials used for manufacture of herbarium is alcohol at a dose 75 %.

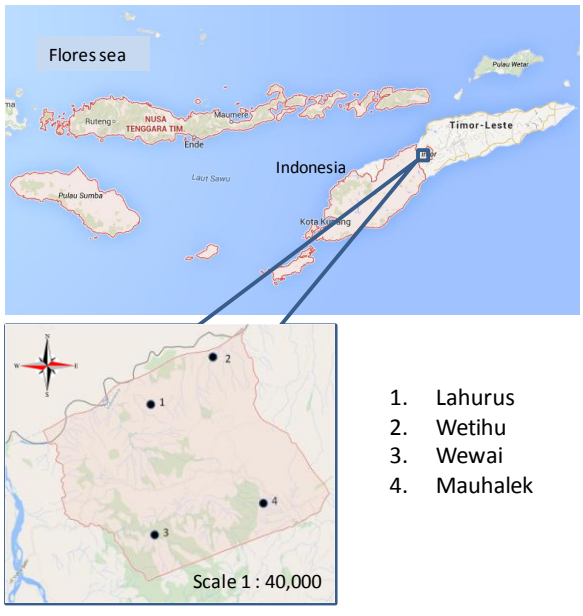

Fig. 1. Map of Study Site.

Plot Determination

Plot determination was determined on the basis by calculation the value of the sampling Intensity of forests area. Sampling intensity used in this study was

10% for the studied area <100 ha. Based on results calculation the sampling intensity and determination of plot size of 20 x 50 meters (0.1 ha) so as obtained 16 plots. Then, 16 plots available distributed to each location of the spring with amount 4 plots to each location. The whole plots is made by nesting means, that is smallest plots located in the deepest part and the greater plot located is getting outside. Plot measuring 2 x 2 meters to analyze vegetation seedling phase, 5 x 5 meters for analyze sapling phase, plot 10 x 10 meters for analyze pole phase and 20 x 50 meters to analyze vegetation tree phase.

Data Collection

Sampling of vegetation collected around the springs include; identification of species, total of species, height and roving. Measurement of ecological parameters that describe the species composition and stratification of vegetation in the study area include relative density, the relative frequency, the relative dominance, an important value index of each species, dominance index and the diversity index of tree phase and similarity index each species on tree phase.

Community Structure

Calculation of the relative density, relative frequency, relative dominance and important value index each the vegetation done after field data was collected. The calculation is performed with formula and procedures contained in Soerianegara and Indrawan, (1983), Odum (1983) and Brower *et al*., (1990) as follows:

$$\textbf{Relative Density} = \frac{density\ of\ a\ species}{density\ of\ all\ species} \times 100\%$$

$$\textbf{Relative Frequency} = \frac{frequency\ of\ a\ species}{frequency\ of\ all\ species} \times 100\%$$

$$\textbf{Relative Dominance} = \frac{dominance\ of\ a\ species}{dominance\ of\ all\ species} \times 100\%$$

$$\textbf{Important Value Index} = Relative\ Density + Relative\ Frequency + Relative\ Dominance$$

Dominance Index

While the dominance index calculation is determined by using equation:

$$Index\ of\ Dominance = \sum \left(\frac{n_i}{N}\right)^2$$

n.i = Importance value of species i

N = Total of Importance Value

Species Diversity Index

Calculation of species diversity index is determined by using the equation:

$$H = -\sum \left\{\left(\frac{n_i}{N}\right) \log \left(\frac{n_i}{N}\right)\right\}$$

H' = Diversity Index of Shannon

n.i = Importance value of species i

N = Total of Importance Value

Community similarity index

Community similarity index calculation was determined using the following formula:

$$SI = \frac{2C}{A + B} \text{ x } 100\%$$

SI = Similarity Index

C = Number of the same species in two community

A = Number of the species in community A

B = Number of the species in community B

Results and discussion

Species composition

Based on the results of research on the four phases of growth (seedling, sapling, poles and trees) which conducted in spring catchment area Lahurus, Wetihu, Wewai and Mauhalek, we found 71 species with amount of individual 1.910 and classified in 30 families. These species are *Alstonia scholaris, Azadirachta indica, Adenanthera pavonina, Albizia procera*, *Aleurites moluccana*, *Aglaia argentea, Adinandra* sp, *Areca catecu, Arenga pinnata*, *Asplenium nidus*, *Ageratum conyzoides*, *Baringtonia asiatica, Bombax ceiba, Bridelia insulana, Calamus* sp., *Caryota mitis*, *Carallia brachiata*, *Cassia fistula*, *Cassia siamea*, *Caesalpinia sappan*, *Commelina nudiflora, Cordial bantamensis*, *Cyathea laterbrosa, Dendrocalamus asper*, *Dysoxylum gaudichaudianum*, *Dysoxylum nutans*, *Dracontomelon dao*, *Erythrina variegata, Eucalyptus alba*, *Eucalyptus urophylla*, *Eupatorium*

inulifolium, Fagraeara cemosa, *Ficus ampelas, Ficus benjamina, Ficus nervosa, Ficus racemosa, Ficus superba, Ficus tintoria, Gastonia serratifolia*, *Glochidion* sp., *Hibiscus tiliaceus, Hura crepitans, Inocarpus fagifer*, *Intsia bijuga*, *Kleinhovia hospital*, *Mangifera minor*, *Melanolepis multigladulosa*, *Melia azedarach*, *Mimosops elengi*, *Morinda citrifolia*, *Nauclea orientalis*, *Orthosiphon aristatus*, *Parkia timoriana*, *Pterocarpus indicus*, *Pterospermum javanicum, Pteris vittata*, *Santalum album, Syzygium polycephalum, Syzigium aqueum, Schleichera oleosa*, *Sterculia foetida*, *Spathodea campanulata, Switenia macrophylla* and *Terminalia catappa*.

Table 1. Results of the vegetation analysis in Lahurus springs.

	No	**Scientific name**	**RD**	**RF**	**RD**	**IVI**
	1	*Spathodea campanulata*	51.3	30.8	51.9	133.9
	2	*Caryota mitis*	20.2	15.4	17.9	53.5
Seedling	3	*Intsia bijuga*	10.5	15.4	12.8	38.7
2X2 m	4	*Ficus exasperate*	13.2	7.7	13.8	34.6
	5	*Ageratum conyzoides*	2.2	7.7	1.9	11.8
	6	Others	2.6	23	1.7	27.5
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Spathodea campanulata*	30.3	11.1	24.4	65.8
	2	*Intsia bijuga*	23.2	11.1	20.8	55.2
Sapling	3	*Melia azetdarach*	3.9	8.3	6.1	18.3
5X5 m	4	*Ficus ampelas*	5.8	5.6	6.5	17.8
	5	*Switenia macrophylla*	5.1	5.6	5.9	16.6
	6	Others	31.7	58.3	36.3	126.3
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Switenia macrophylla*	18.4	5.4	25.1	48.9
Poles	2	*Caryota mitis*	12.8	10.8	10.7	34.3
10X10 m	3	*Spathodea campanulata*	11.9	10.8	7.2	30
	4	*Melia azetdarach*	9.2	8.1	10	27.2
	5	*Syzygium polycephalum*	6.4	8.1	10.4	24.9
	6	Others	41.3	56.8	36.6	134.7
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Intsia bijuga*	11	12.1	16.9	40
Trees	2	*Syzygium polycephalum*	9.6	9.1	18.4	37.1
20X50 m	3	*Swietenia macrophylla*	16.4	9.1	5.4	30.9
	4	*Ficus benjamina*	8.2	6.1	16	30.3
	5	*Spathodea campanulata*	8.2	9.1	6.7	24
	6	Others	46.6	54.5	36.6	137.7
	TOTAL		**100**	**100**	**100**	**300**

Note: RD=relative density; RF=relative frequency; RD=relative dominance; IVI=Important value index.

a. Results of the vegetation analysis in Lahurus springs

The results of analysis species composition and stratification of vegetation found 33 species with amount of 565 individual. Species is found to have value of relative density, relative frequency, relative dominance and the important value index varied (Table 1).

In catchment areas Lahurus was found one species dominate with value relative density highest at two phase growth (*seedling* and *sapling*) is *Spathodea campanulata* with a value of 51.3% and 30.3% while pole phase and trees are dominate based on highest relative density is species *Swietenia macrophylla* with a value 18.4% and 16.4%. Furthermore, species with highest value based on parameters of the relative frequency in seedling phase is *Spathodea campanulata* with value of 30.8%. At saplings phase be found two species that have highest relative frequency namely *Intsia bijuga* and *Spathodea campanulata* with a value of 11.1%. In pole phase be found two species with value relative frequency highest namely *Caryota mitis* and *Spathodea campanulata* with a value of 10.8%, at tree phase species with the highest relative frequency is *Intsia bijuga* with a value of 12.1%. While the results of calculation relative dominance known *Spathodea campanulata* is a species that has the highest value on two phases , namely seedlings and saplings with a value 51.9% and 24.4%. At the pole phase a species with highest relative dominance is *Swietenia macrophylla* with a value 25.1%. Whereas at tree phase *Syzygium polycephalum* is a species with the highest relative dominance value of 18.4%. The next parameter is calculation of important value index. The important value index is result of sum relative values out of three parameters (density, frequency and dominance) that have been previously analyzed. The results of analysis at springs Lahurus found in species that has highest important value index and also become dominant species in the seedling phase is *Spathodea campanulata* with a value 133.9%. At sapling phase *Spathodea campanulata* and *Intsia bijuga* are co-dominant with important value index of 65.8% and 55.2%. Whereas tree phase of *Intsia bijuga, Syzygium polycephalum, Ficus benjamina* and *Switenia macrophylla* are co-dominant with range of important value index between 30.3%-40%.

b. Results of the analysis vegetation in Wetihu springs

Based on calculation species composition and stratification of vegetation on the samples plot in springs catchment areas Wetihu be found 32 species with amount of 749 individual. After data analysis found several species that have values relative density, relative frequency, relative dominance and the important value index the highest (Table 2).

Table 2. Results of the vegetation analysis in Wetihu springs.

	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Intsia bijuga*	83.5	16	71.9	171.3
Seedling	2	*Ageratum conizoides*	7.9	12	17.4	37.3
2X2 m	3	*Ficus ampelas*	0.8	12	3.7	16.5
	4	*Eupatorium inulifolium*	2.6	12	1.4	16
	5	*Aglaia argentea*	1.3	12	0.4	13.7
	6	Others	3.9	36	5.2	45.2
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Aglaia argentea*	42.3	15.4	43.8	101.5
	2	*Carallia brachiata*	11.5	15.4	19.1	46
Sapling	3	*Intsia bijuga*	9.6	11.5	9.7	30.9
5X5 m	4	*Caryota mitis*	9.6	7.7	6.2	23.5

	No	Scientific Name	RD	RF	RD	IVI
	5	*Ficus ampelas*	7.7	11.5	3.6	22.8
	6	Others	19.3	38.5	17.6	75.3
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Caryota mitis*	35.3	16	35.6	86.9
Poles	2	*Intsia bijuga*	20	12	20.1	52.1
10X10 m	3	*Aglaia argentea*	14.1	8	12.1	34.2
	4	*Ficus ampelas*	9.4	12	9.5	30.9
	5	*Alstonia scholaris*	5.9	12	5.3	23.2
	6	Others	15.3	40	17.4	72.7
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Alstonia scholaris*	23.1	12.1	37	72.2
Trees	2	*Intsia bijuga*	24.4	12.1	1.9	38.4
20X50 m	3	*Ficus ampelas*	10.2	9.1	7.9	27.2
	4	*Ficus exasperata*	7.7	6.1	12.4	26.2
	5	*Aglaia argentea*	3.8	9.1	2.1	15.1
	6	Others	30.8	51.5	38.7	120.9
	TOTAL		**100**	**100**	**100**	**300**

Note: RD=relative density; RF=relative frequency; RD=relative dominance; IVI=Important value index].

From result of analysis known to species with the highest relative frequency values on the two phases of growth (seedlings and trees) is *Intsia bijuga* with value each phase 83.5% and 24.4%. At sapling phase a species that have highest relative density is *Aglaia argentea* with a value 42.3%. In the pole phase, species with highest relative density is *Caryota mitis* with a value 35.3%.Furthermore, the results of calculation relative frequency in Wetihu springs indicate *Intsia bijuga* is a species that has highest value on the seedling phase with value of 16%. At sapling phase a species that have highest relative frequency are *Carallia brachiata* and *Aglaia argentea* with a value 15.4%. At pole phase a species that have highest relative frequency found on the *Caryota mitis* with a value 16%. At tree phase the species with highest relative frequency are *Intsia bijuga* and *Alstonia scholaris* with a value 12.1%. The next parameter is calculation relative dominance. Results of calculation show that *Intsia bijuga* is a species dominate on the seedling phases with a value 71.9%. At sapling phase *Aglaia argentea* is species dominance with the highest relative value of equal 43.8%. At poles phase a species that have highest relative dominance is *Caryota mitis* with a value of 35.6%, while on the phase tree a species that have the highest relative dominance is *Alstonia scholaris* with a value of 37%. The next parameter is calculation of important value index, an important value index Wetihu springs seedling phase to tree phase namely; on seedling phase *Intsia bijuga* is a species dominant with important value index 171.4%. At sapling phase *Aglaia argentea* completely dominant with an important value index 101.5% and at poles phase *Caryota mitis* completely dominant with an important value index 86.9%. Whereas tree of phase *Alstonia scholaris* completely dominant with an important value index 72.2%.

c. Results of the analysis vegetation in Wewai springs

Based on results calculation of species composition and stratification of vegetation on sample plots Wewai springs, be found 34 species with amount 231

individuals. Species that have value of relative density, relative frequency, relative dominance and importance value index of the highest in seedling phase to tree phase are presented in Table 3.

Table 3. Results of the Vegetation Analysis in Wewai springs.

	No	Scientific Name	RD	RF	RD	IVI
	1	*Intsia bijuga*	19	10.3	19.5	48.8
	2	*Mangifera minor*	19	10.3	15.7	45
Seedling	3	*Aglaia argentea*	8.6	10.3	11.8	30.8
2X2 m	4	*Syzygium polycephalum*	8.6	7	12.6	28.1
	5	*Spathodea campanulata*	8.6	13.8	5.1	27.5
	6	Others	36.2	48.3	35.3	119.8
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Intsia bijuga*	9.8	9.1	48.2	67.1
	2	*Aglaia argentea*	19.6	9.1	18.9	47.6
Sapling	3	*Morinda citrifolia*	7.9	12.1	5.3	25.3
5X5 m	4	*Syzygium polycephalum*	7.8	9.1	4	20.9
	5	*Carallia brachiata*	7.8	9.1	3	19.9
	6	Others	47.1	51.5	20.6	119.2
		TOTAL	**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Syzygium polycephalum*	17.7	6.9	16.6	41.2
Poles	2	*Mangifera minor*	12.9	6.9	20.9	40.7
10X10 m	3	*Syzigium aqueum*	6.5	6.9	9	22.3
	4	*Carallia brachiata*	6.5	6.9	8.4	21.8
	5	*Kleinhovia hospital*	8	6.9	5.7	20.7
	6	Others	48.4	65.5	39.4	153.3
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Mangifera minor*	32.2	18.2	28	78.3
Trees	2	*Terminaliacatappa*	11.9	13.6	25.9	51.4
20X50 m	3	*Syzygiumpolycephalum*	16.9	4.5	15.3	36.8
	4	*Syzigiumaqueum*	13.6	9.1	12.2	34.8
	5	*Intsiabijuga*	6.8	13.6	4.7	25.2
	6	Others	18.6	41	13.9	73.5
	TOTAL		**100**	**100**	**100**	**300**

Note: RD=relative density; RF=relative frequency; RD=relative dominance; IVI=Important value index.

The results of calculations relative density at seedling phase in Wewai springs was found two species that have highest value namely *Mangifera minor* and *Intsia bijuga* with a value 19%. At pole phase a species that have highest relative density was found on *Aglaia argentea* with a value 20%. At pole phase a species with the highest relative density was found in *Syzygium polycephalum* with value 17.7%. At three phases a species that have highest relative density was found in *Mangifera minor* with a value 32.2%. Furthermore, species that have highest relative frequency in Wewai springs are as follows; Seedling

phase is *Spathodea campanulata* with a value 14%. At sapling phase is *Morinda citrifolia* with a value 12.1%. At pole phase are *Syzygium* sp., *Ficus ampelas, Baringtonia asiatica* and some other species with value 6.9%. At tree phase a species with highest relative frequency is *Mangifera minor* with value 18.2%.

Results of data analysis the relative dominance in Wewai springs shows one of species that has highest relative dominance on two phase (seedlings and saplings) is *Intsia bijuga* with value 19% and 48.2%, while the pole phase and tree phase a species that have highest relative dominance is *Mangifera minor* with value 20.9% and 27.9%. Furthermore, based on data analysis obtain species that had highest importance value index and become species are dominant or co-dominant in Wewai springs. A species is said to be dominant if species had the highest importance value index and the difference of value is quite significant while the species is said to be co-dominant if the species had highest importance value index, but is found in more than one species with difference value not significant. At seedling phases a species with highest importance value index was found in *Mangifera minor* and *Intsia bijuga* with important value index by 45% and 48.8%. At sapling phase *Intsia bijuga* is dominant with important value index 67.1%. At pole phase *Mangifera minor* and *Syzygium polycephalum* are co-dominant with important value index of 40.7% and 41.2%, while tree phase *Terminaliacatappa* and *Mangifera minor* are codominant with important value index 51.4% and 78.3%.

d. Results of the analysis vegetation in Mauhalek springs

Based on results analysis of species composition and stratification of vegetation on sample plots Mauhalek spring was found 31 species with amount 365 individual. Species that have value relative density, relative frequency, relative dominance and the importance value index highest presented in Table 4.

Table 4. Results of the vegetation analysis in Mauhalek springs.

	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Spathodea campanulata*	72.9	26.6	57.9	157.5
	2	*Intsia bijuga*	12.7	20	18.6	51.3
Seedling	3	*Cyathea laterbrosa*	3.9	13.3	8.9	26.1
2X2 m	4	*Ageratum conyzoides*	7.7	6.7	10.5	24.9
	5	*Asplenium nidus*	0.6	6.7	1.3	8.5
	6	Others	2.2	26.7	2.8	31.7
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Intsia bijuga*	24.3	20	17.2	61.5
	2	*Spathodea campanulata*	18.9	20	18.1	57.1
Sapling	3	*Mangifera minor*	10.8	10	21	41.8
5X5 m	4	*Gastonia serratifolia*	16.2	15	5.2	36.4
	5	*Carallia brachiata*	8.1	5	8.4	21.5
	6	Others	21.7	30	30.1	81.7
	TOTAL		**100**	**100**	**100**	**300**
	No	**Scientific Name**	**RD**	**RF**	**RD**	**IVI**
	1	*Arenga pinnata*	27.4	9.4	35.5	72.3
Poles	2	*Carallia brachiata*	15.1	12.5	12.9	40.5
10X10 m	3	*Spathodea campanulata*	13.7	12.5	14.2	40.4

	No	Scientific Name	RD	RF	RD	IVI
	4	*Ficus ampelas*	8.2	12.5	7.7	28.4
	5	*Intsia bijuga*	9.6	9.4	6	24.9
	6	Others	26	43.7	23.7	93.5
	TOTAL		**100**	**100**	**100**	**300**
	NO	**SCIENTIFIC NAME**	**KR**	**FR**	**DR**	**INP**
	1	*Spathodea campanulata*	32.4	14.3	26.5	73.2
Trees	2	*Intsia bijuga*	16.2	14.3	25.2	55.7
20X50 m	3	*Syzygium polycephalum*	18.9	7.1	21.1	47.1
	4	*Ficus exaperata*	8.1	10.7	8.4	27.3
	5	*Mangifera minor*	2.7	7.1	3.1	12.9
	6	Others	21.7	46.5	15.7	83.8
	TOTAL		**100**	**100**	**100**	**300**

Note: RD=relative density; RF=relative frequency; RD=relative dominance; IVI=Important value index

Based on data in table 4 are known *Spathodea campanulata* is species that has value of relative density highest at the seedling phase and tree phase with value 73% and 32.4%. At sapling phase a species with highest relative density was found in *Intsia bijuga* with value 24.3%. At the pole phase found in species *Arenga pinnata* with a value 27.4%. Furthermore, results of analysis relative frequency show that *Spathodea campanulata* is a species that has the highest relative frequency on seedling phase with value 26%. At sapling phase was found two species that have highest relative density namely *Spathodea campanulata* and *Intsia bijuga* with value 20%. At pole phases was found three species that have highest relative frequency namely *Carallia brachiata, Ficus ampelas* and*Spathodea campanulata* with value 12.5%. At tree phase was found two species that have highest relative frequency namely *Spathodea campanulata* and *Intsia bijuga* with value 14.3%.

Meanwhile, a species that has highest relative dominance in Mauhalek springs are as follows; at seedling phase and tree *Spathodea campanulata* is a species with the highest value is equal to 57.9% and 26.5%. At sapling phase a species with the highest value is *Mangifera minor* with value 21 %. At pole phase a species with the highest value is *Arenga pinnata* with value 30.5%. For the important value index at Mauhalek springs species *Spathodea campanulata* is dominant at seedling phase with important value index 157.5%, the sapling phase *Spathodea campanulata* and *Intsia bijuga* are co-dominant with important value index by 57% and 61.5%. At pole phase *Arenga pinnata* is dominant with an important value index with value 72.3%. While the trees of phase *Spathodea campanulata* and *Intsia bijuga* are co-dominant with important value index 73.2% and 55.7%.

Based on data analysis at springs Lahurus, Wetihu, Wewai and Mauhalek was found species composition and stratification of vegetation on sample plot has varied value both relative density, relative frequency, relative dominance and importance value index. Variations in the value of each species illustrate the difference in the character of the growth each species in plant communities were observed. Kimmins (1987) variation in species composition and stratification of vegetation in a community is influenced by several factors such as phenology, dispersal and birthrate. The success of a species into a new individual is influenced by fertility and fecundity different of each species so that there are differences species composition and stratification of vegetation in it. Ludwig and Reynolds (1988) patterns distribution of species within a community varies because due to several interacting factors, among others: (i) Vectorial

factors (intrinsic), that is internal environmental factors such as wind, water, and light intensity, (ii) capacity factor reproductive of organisms, (iii) social factors related to plant phenology, (iv) Co-active factor is an impact inter specific interactions, and (v) stochastic factors which are the result of random variation of several factors that influent.

Density value indicates amount individuals of species in question and an overview as to the amount of species found in around springs in Lasiolat District. Species that have relatively high density values and is a species are many found in sample plots created and become dominant or co-dominant species (based on relative density) in the study area. Soerianegara and Indrawan, (1983) density of a species is a value that indicates the amount or number of species per unit area, the greater the density of a species, the more individuals of that species per unit area. However the value of the density is not sufficient provide an overview of distribution and dispersal patterns of plants in question at the study site. An overview of distribution and pattern of distribution of a particular species can be seen in the value of relative frequency, value of relative dominance and important value index and or variants of the overall population.

Frequency value is the magnitude of intensity was found a species in the observations or presence of species in communities were observed. Barbour et al., (1980) frequency of species is showing distribution of species in particular area. Species are spread equitably has a large frequency value. Conversely, species has a small frequency values have less extensive distribution area. The results of calculations relative frequency at study site shown there are variations in the value of each study site. Some species which has high relative frequency value at the four study sites are *Spathodea campanulata, Intsia bijuga, Caryota mitis, Mangifera minor* and *Ficus sp*. The high value of relative frequency each species because this species is always found in sample plots are made and become species dominant and co-dominant in the study area.

The variation of value frequency of a species is directly influenced by the density and patterns distribution (Greig-Smith, 1983). Kershaw (1978) and Crawley (1986), frequency of species in a particular community is determined by sampling method, size of the plot, plant size and spatial distribution. In this research, the selection of method and placement plots has been carried out by standard procedures so that frequency value the obtained expected of the really describe conditions on the ground. Therefore, species that has a density value and frequency high including species that has a good adaptability the environmental conditions in which it grows. Distribution of plants in a particular community is limited by environmental conditions in a broad sense. Some species in tropical forests have adapted with conditions under canopy, mid and above of canopy with different light intensity (Balakrishnan *et al*., 1994). The success of a species to occupy an area be affected by its ability to adapt optimally to all physical environmental factors (temperature, light, soil structure, etc.) and chemical factors include the availability of water, oxygen, pH, nutrients in the soil, and the others (Krebs, 1978).

Dominance is a parameter which indicates domination of a particular species in a plant community and or the characterized of life the species in its natural environment (Barbour *et al*., 1980). Species that have the highest relative dominance in four locations among other observations *Spathodea campanulata*, *Swietenia macrophylla*, *Intsia bijuga*, *Aglaia argentea*, *Caryota mitis*, *Alstonia scholaris*, *Mangifera minor*, *Arenga pinnata*, *Syzygium* and *Ficus* sp. Based on result of research, these species have adaptability good enough with environmental conditions because the tendency to have high seed production and germination rate reached 90% so it can be categorized as dominant and co-dominant species in each phase of growth based on value the relative dominance.

Based on results of the calculation relative density, relative frequency and relative dominance are found

certain species that have importance value index highest >50%. These species are *Spathodea campanulata*, *Caryota mitis*, *Intsia bijuga*, *Aglaia argentea*, *Alstonia scholaris*, *Mangifera minor*, *Arenga pinnata* dan*Terminalia catappa*. Nevada (2007), species with important value index is greater than other species indicates that species has rate of conformity are good and have the survival are better when compared with other species. Sundarapandian and Swamy (2000), importance value index is one of the parameters that can give an idea of the role of species concerned in the community or at the study site. Species Caryotamitis, *Spathodea campanulata*, *Intsia bijuga*, *Aglaia argentea*, *Terminalia catappa* and *Ficus* sp., are an overview of the species that predominate in each springs based on important value index, this is because these species have relative density, relative frequency and relative dominance of the highest in each location so that effect on the high value of important value index each species. The presence of trees species on a particular area indicates ability of trees to adapt with in local environmental conditions, so become are dominant or co-dominant species in an area and can be expressed as a species that has the adaptability and greater tolerance to environmental conditions.

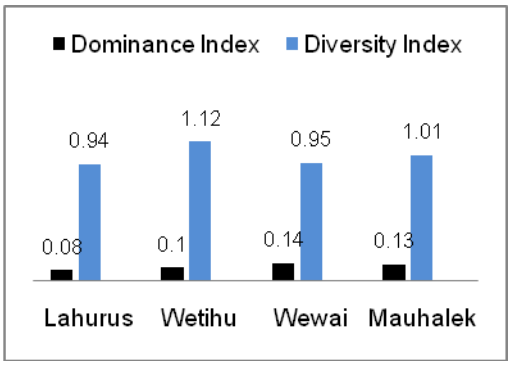

Fig. 2. The dominance index and diversity index of vegetation at three phases.

Based on results of sum the important value index furthermore can be calculated dominance index and diversity index of vegetation to each study site. Dominance index is a parameter that describes the pattern of concentration (dominance) and the distribution of species in a community growth while the diversity index is a parameter that expresses the value of species diversity in a plant community (Indriyanto, 2008). Results of calculation the dominance index and diversity index vegetation tree phase on the study site is presented in fig. 2.

From results of the quantitative analysis known dominance index on tree phase in each study site has value <1, this means there is no species dominate to other species or structure of communities in a stable because value of dominance index =0. Dominance index is an inverse of the diversity index of species, because pattern centralizing had better occurs at a low diversity. Odum (1996), diversity index is used to known the influence of disturbance to the environment or to know the stages of succession and stability of plant communities on a location. Based on results of research known diversity index of species tree phase in the study area has value 0.94 to 1.12. From these values it can be seen that the growth phase of tree vegetation in the study area has an index of species diversity is low to moderate (0-1 and ≤3). Soerianegara and Indrawan (1983), index of dominance and diversity species are contradictory indicator, when the high dominance index mean diversity index is low and instead. The high and low diversity of species present in a community is influenced to rainfall, soil and altitude. The higher a value of diversity species, a growing number of these species are found in the study site.

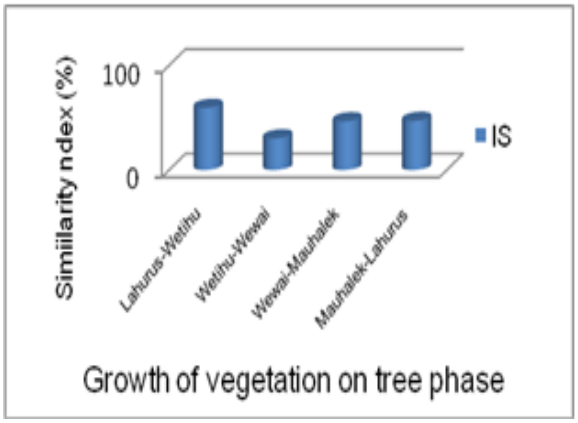

Fig. 3. Similarity index of species the tree phases in the study site.

The results calculation of similarity index of vegetation on tree phase in the study area indicated there is variation of value (Fig. 3). For springs Lahurus-Wetihu similarity index of 59.4%. At Wetihu-Wewai springs have the similarity index 30.3%. In Wewai-Mauhalek springs similarity index of 46.6%, while similarity index Mauhalek-Lahurus springs is 47%.

Relationship of vegetation parameters and conservation of springs

The density of a species and land use in the catchment area has a directly proportional relationship with water availability to the springs. This is due to the presence of vegetation in the catchment area causing rain water does not immediately fall to ground but still restrained by canopy of vegetation and if the condition of vegetation on water catchment areas have a high density, the total water that absorbed into ground will a lot more than become to surface flow. Prasetyo (2001) stated that there is a strong correlation between the density vegetation in one place with rise and fall of groundwater discharge (that slowly out onto the surface out for springs) in the area. Connection with this, Fetter (1988) argued that the entry of water into ground due to tensile force vertically into the ground. Tensile force is derived from the roots of plants, because for photosynthesis needed is water absorbed from the surrounding area so that increasingly dense of vegetation in an area, the greater the water is absorbed into the soil.

Results of research conducted by Dauwani (2012), the analysis about run off coefficient for controlling direct run off in Citarum suggests that changes in flow rate is directly proportional to the change in the coefficient value of the runoff. Where there is a change in land cover in the watershed Citarum between 1989 and 1997 turned out to have an impact on the discharge changes both in wet and dry months in the watershed. However, after the closure of the land turned from moderate to dense vegetation then discharge the waters increased.

Based on result of observations and the results of data analysis relating to the conservation of water source known to vegetation around the springs on four springs water has a density which is included in both categories. However, logging of trees and changes land use around the springs resulting in changes shape of land cover on community land directly adjacent to the springs that have negative impact on the continuity of existing water sources and it is suspected to be cause decreasing discharge of springs in Lasiolat District.

Frequency of vegetation is form of distribution and dispersal patterns of plant also have a correlation to water source conservation. If the distribution and the dispersal patterns of species evenly in the study area then will give away a positive influence over the resulting litter and the root systems are varying from each vegetation will help improve properties of physical and the chemical of the soil, and the end will affect the ability of soil to absorb water and vegetation in reducing surface water runoff. Lee (1986), interception of forest canopy can reduce the amount of precipitation that reaches the ground. Water in the soil (soil moisture) is released into the air through the root system, stems and foliage in the process of transpiration. In the end, the root system, organic matter, and litter will increase infiltration rate and soil water storage capacity (ground water). Vegetation can provide the best possibilities for the physical improvement and chemical properties of soil. This relates to the litter produced vegetation of tree phases is high enough. As a result, content of organic matter on the forest floor increased. In addition, infiltration capacity of forest becomes higher than non-forest land cover. Thick litter layer also will increases the biological activity of the soil. The turn of tree root are very dynamic in the long term can lead to discovered large pores (*macroporosity*) on forest land, consequently forest land has percolation rate much higher (Singer and Purwanto, 2006).

The results the study on four spring water in Lasiolat District shows there are some species that dominates

and has an important role in the conservation of water sources. These species are *Spathodea campanulata*, *Intsia bijuga*, *Aglaia argentea*, *Caryota mitis*, *Alstonia scholaris*, *Mangifera minor*, *Arenga pinnata*, *Syzygium* sp. and *Ficus* sp. These species are local species that has deep roots architecture and is able to grow and develop optimally around the springs in the study site. Other species of the family Poaceae were also found to grow well in the study area is *Dendrocalamus asper*. Species *Dendrocalamus asper* is a species of bamboo local name *betung* that have high ecological value in soil and water conservation efforts. While other species that are not a local species but grows well in the study site is *Swietenia macrophylla*, this species is result of reforestation, but the currently this vegetation is considered to have contributed greatly to the presence of springs in springs Lahurus so by the government, the species *Swietenia macrophylla* there are around these springs also protected and used as plant conservation. Other than the above species there were also some species of the tribe Moraceae such as species *Ficus* sp. which has an important role in the conservation of soil and water. The ability of species *Ficus* sp. as soil and water conservation plant because it has strong roots architecture and is able to bind soil particles in surrounding. Type of canopy on this species also have positive impacts on soil and water conservation because it has the dense canopy so rated can withstand direct blows rain water and reduce soil erosion and increase infiltration (Fiqa *et al*, 2005).

Forest around the springs is very important to suppress the occurrence of surface flow (*run off*) and otherwise would increase the infiltration of rainwater into the ground. Tree roots will bind soil and water and resist soil or sediment the result deposition the stream of rainwater from non-forested areas. Canopy of plants able to withstand granular of rainwater that falls above the surface of the ground and can reduce soil erosion, the ability of rainwater reached ground below vegetation depends on the rainfall intensity and duration as well as the configuration and the leaf density (Whitten *et al.*, 1996).

Stratification of Vegetation

The stratification is one component that is used to describe structure of vegetation vertically. Distribution of vegetation is vertically can be seen from a number of layers canopy contained in a forest area among other is highest ends, top canopy, bottom canopy, shrub layer and layer of the ground floor (Richards, 1952). Stratification occurs due to two important things experienced by plants in the formation of life namely due to the competition between plant and tree species tolerance to the intensity of solar radiation. The impact of these competition, then arise the tree species that can compete, superior, strong and become the dominant species (Vickery,1984).Individual classification based on grade level in four study sites fig. 4.

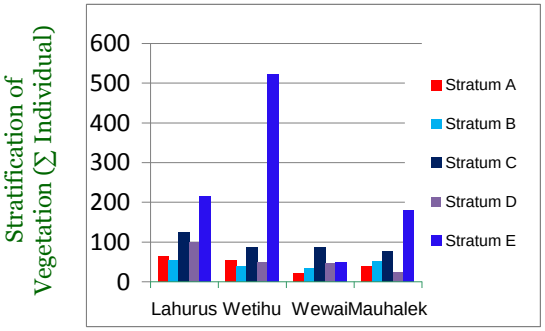

Fig. 4. Individual classification based on grade level in four study sites.

Stratification of vegetation on four springs classified as complete from Stratum A to E. The sum of individual based on grade level in four study sites the of each are as follows: Lahurus 62 individual on stratum A, 53 individual on stratum B, 125 individual stratum C, 100 individual on stratum D and 215 individual at stratum E. Wetihu 52 individual stratum A, 37 individual stratum B, 87 individual stratum C, 48 individual stratum D and 523 individual on stratum E. Wewai 19 individual stratum A, 32 individual stratum B, 86 individual stratum C, 46 individual stratum D and 47 individual on stratum E while Mauhalek 37 individual stratum A, 51

individual stratum B, 75 individual stratum C, 23 individual stratum D and 179 individual stratum E.

Total species found on Lahurus, Wetihu, Wewai, and Mauhalek springs are 71 species with total individual of 1.910 and categorized in 30 families. At Lahurus springs found in 33 species with amount of families 19. At the Wetihu springs be found 32 species with amount of families 21. At the Wewai springs found in 31 species with amount of families 19 and at the Mauhalek springs found in 34 species with amount of families 18. Species that predominate in Lahurus springs, Wetihu springs, Wewai springs, and Mauhalek springs are *Intsia bijuga*, *Spathodea campanulata*, *Aglaia argentea, Arenga pinnata*, *Mangifera minor*, *Syzygium polycephalum, Syzigium aqueum* and several species of *Ficus* sp. Whereas species with value of relative density, relative frequency, relative dominance and the important value index highest found on *Spathodea campanulata, Aglaia argentea, Intsia bijuga, Caryota mitis, Ficus nervosa, Arenga pinnata* and *Terminalia catappa* with important value index> 50%.

Based on data analysis at springs Lahurus, Wetihu, Wewai and Mauhalek was found species composition and stratification of vegetation on sample plot has varied value both relative density, relative frequency, relative dominance and importance value index. Variations in the value of each species illustrate the difference in the character of the growth each species in plant communities were observed. Stratification of vegetation around the springs be viewed of stratum classified was complete from the stratum A to E.

Forest around the springs is very important to suppress the occurrence of surface flow (*run off*) and otherwise would increase the infiltration of rainwater into the ground. Tree roots will bind soil and water and resist soil or sediment the result deposition the stream of rainwater from non-forested areas. Canopy of plants able to withstand granular of rainwater that falls above the surface of the ground and can reduce soil erosion; the ability of rainwater reached ground below vegetation depends on the rainfall intensity and duration as well as the configuration and the leaf density.

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