Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.22, 2015

Structure of Mangrove Community in Coastal of Mempawah Regency, West Kalimantan Province

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ABSTRACT

Mangrove ecosystem should always be preserved in order to keep its ecological functions. This study aims to analyze structure and distribution of mangrove in Mempawah District, West Kalimantan Province. This study was conducted on November 2014 until May 2015 with five transects that spread in four districts of coastal area and one in the island which was identified through Landsat 8 image recording, recording on February 6t^{h} 2014 showed that the area of 739.31 hectares grown by mangrove. Each station was conducted research using quadratic transect method as with Indonesian National Standard (INS) No. 7717 of 2011 about Mangrove Surveying and Mapping and Regulation of the Information and Geospatial Agency Leader Number 3 Year of 2014 About Technical Guidelines Geospatial Data Collection and Processing of Mangrove. The study found that 13 species of mangrove consisted and included in 5 tribes which were the main component of mangrove in the District Mempawah with good conditions.
Keywords: Mangrove, Landsat 8 Image, INS

1. INTRODUCTION

As with the increase of population that needs area for housing, farming, industry, port service, and other facilities, thus land conservation which becomes mangrove habitat also getting increase. The use of land which grown by mangrove often conducted in over activity because it is not based on well calculation and processing plan in which society amazed by short term economic calculation and less understanding and people's awareness about benefit, function, and high value of mangrove. Therefore, it needs to identify mangrove structure and distribution, thus it can be known the type and distribution pattern which finally can be used for the use of mangrove ecosystem sustainably in order to prosper coastal people in Mempawah Regency.

2. METHOD

To see a phenomenon in coastal area, especially mangrove forest, it can be used by using remote sensing technology. Mangrove location which placed in the confluence area between sea and land gives spectral characteristic that different with other vegetation object. Water object is really strong in absorb electromagnetic wave, in opposite with vegetation object which reflects very strongly. Band using in red wave and near infrared which has low reflection characteristic to the water object is very suitable to be used in identifying mangrove (Suwargana, 2008). Mangrove object which located in coastal ecosystem will seen darker or has contrast color if it is compared with other vegetation object in the land (Faizal, et al., 2005).

As with the publishing of Act No 4 Year of 2011 about Geospatial information, in conducting spatial analysis must use accountable data (Karsidi, 2012). Spatial data base that used is Indonesia Topography Map (Peta Rupabumi Indonesia-RBI) which is topography map that shows many natural and artificial elements in the area of United Indonesia Republic (NKRI). The steps as follow:

1. initial step is preprocessing, which is mosaic, radiometric correction, geometric correction, and image cutting. Study area covered by 2 scenes of landsat image path 122 raw 60 and path 121 raw 60, thus both scenes need to be combined (mosaic).
2. the next step is radiometric correction and geometric correction. Radiometric correction aims to fix pixel value as with reflection value of actual object. Radiometric correction that used is dark substrate, where it is assumed that the lowest pixel value is 0. Then it is continued by geometric correction, in which this correction aims to fix image position as with the actual position. The geometric correction uses reference data of Indonesia Topography Map (RBI) 1:50,000 by using image to map method. The last process is cutting image scenes as with study area.

3. the next is visualizing image with composite RGB 564 in landsat 8. Then, it was sharpened by using specification histogram sharpening technique, thus mangrove color becomes red. After that, it is delineation process with digitations on screen using software Arc GIS 10.
4. the next step is mangrove area limitation in 2014 used to cut scene band 5 and band 4. Band 4 and band 5 then used to calculate NDVI, thus the calculated NDVI is only in the mangrove area.
5. the next is calculating NDVI in the scenes of landsat 8 image year of recording 2014. The formulation as follow:

$$NDVI = \frac{(Band\ 5 - Band\ 4)}{(Band\ 5 + Band\ 4)}$$

The research was conducted in 5 (five) stations through sampling cluster approach in the area per district and 1 island that grown by mangrove. It included station:
1. Sungai Pinyuh District in the mouth of pinyuh river
2. Mempawah Timur District in the mouth of bakau kecil river
3. Mempawah Hilir District in Benteng Village
4. Sungai Kunyit District in Sungai Limau Village
5. Sungai Kunyit in Temajo Island

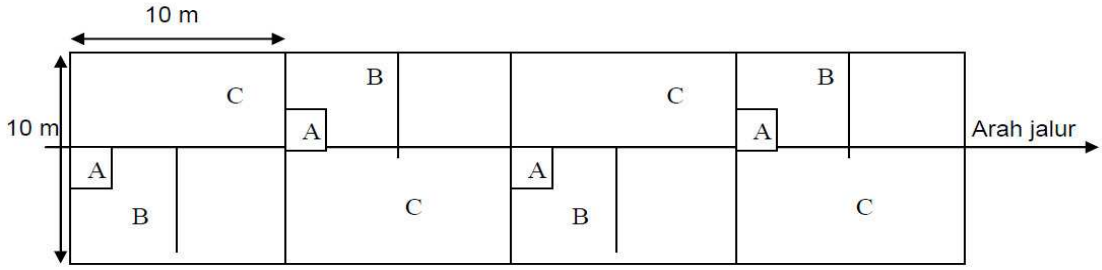

Figure 1. Design Examples of Mangrove Observation with Path Method

Mangrove identification was conducted as with Indonesian National Standard (INS) No. 7717 of 2011 about Mangrove Surveying and Mapping and Regulation of the Information and Geospatial Agency Leader Number 3 Year of 2014 About Technical Guidelines Geospatial Data Collection and Processing of Mangrove as follow:

1. Seedling: 1 m x 1 m, diameter < 2 cm
2. Sapling: 5 m x 5 m, diameter 2 cm – 10 cm
3. Tree: 10 m x10 m, diameter > 10 cm

According to Onrizal and Kusmana (2005) in Nurahman (2012), calculation of parameter quantitative value of mangrove flora in the determination of Important Value Index (INP) conducted by this formula:

Density of a type (K) (stand/ha)

$$K = \frac{\Sigma \text{ individu of a type}}{\text{Observation plot area}}$$

Relative density of a type (KR) (%) K of a type

$$KR = \frac{K}{K \text{ all types}} \times 100\%$$

Frequency of a type

$$F = \frac{\Sigma \text{ plot of a type found}}{\Sigma \text{ all observation plots}}$$

Relative frequency of a type (FR) (%)

$$FR = \frac{F \text{ of a type}}{F \text{ all types}} \times 100\%$$

Domination of a type (D) (m^2/ha). Only for tree level

$$D = \frac{\text{Basic area of a type}}{\text{Area of observation plot}}$$

Relative domination of a type (DR) (%). Only for tree level

$$D = \frac{D \text{ of a type}}{D \text{ all types}}$$

Important Value Index (%)

1. For tree : INP = KR + FR +DR
2. For seeding and sapling : INP = KR + FR

Important Value Index (INP) of a type for sapling and seeding between 0-200, whereas for tree between 0-300. INP gives a description about the effect or role of a mangrove type in mangrove community.

3. RESULT AND DISCUSSION

Mangrove area at Mempawah Regency in 2007 for 869.02 Ha (Kabupaten Pontianak dalam angka, 2007). This data was last data of mangrove area that reordered in Statistic Central Bureau (BPS) of Mempawah Regency in which after that until 2014, BPS of Mempawah Regency or BPS of West Kalimantan Province not published the mangrove area anymore.

Through Geographic Information System (SIG) mangrove area in Mempawah Regency for 739.31 Ha, that area was decrease for 129.71 Ha in the last 6 years.

Table 1. Mangrove Area in Mempawah Regency

Districts	An area (Ha)[a]	Mangrove wide (Ha)
Mempawah Hilir	16.042,53	186,16
Mempawah Timur	11.253,87	21,6
Sungai Kunyit	19.487,1	147,38
Sungai Pinyuh	18.264,93	384,17
Total	65.048,43	739,31

[a] [RBI BIG 1: 50.000] Source : primary data

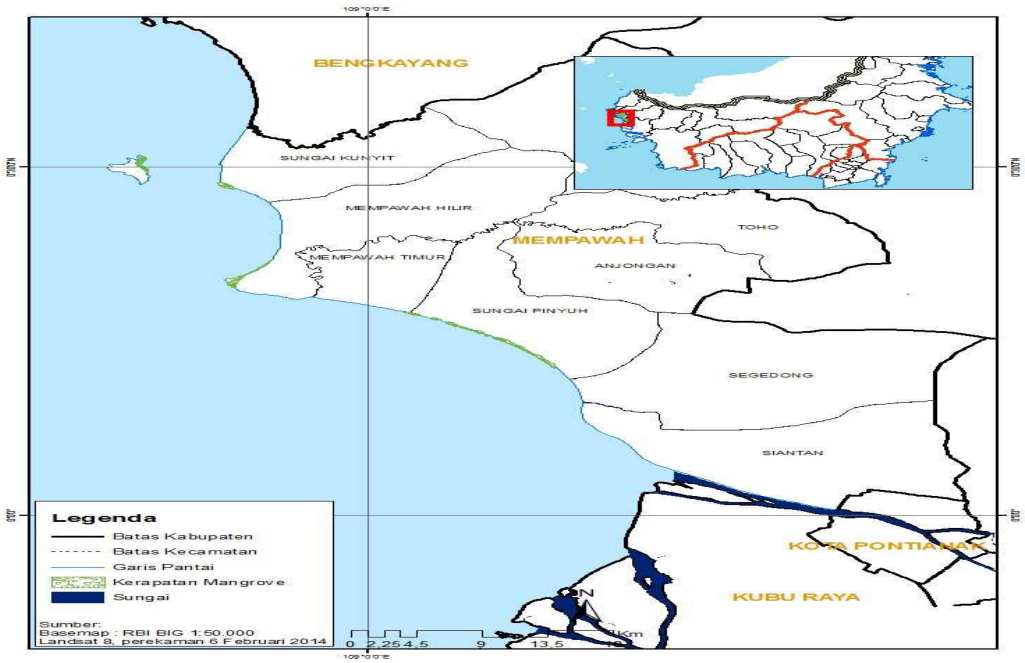

Figure 2. Identification of Mangrove in Mempawah Regency

13 types of mangrove that was found consisted of 5 tribes which were the main component of mangrove vegetation in Mempawah Regency

Table 2. Types of mangrove vegetation in the Mempawah Regency

Local name	Scientific name	Tribe	IUCN Status
Api-api jantan	*Avicennia alba*	*Acanthacaeae*	Low risk
Api-api betina	*Avicennia marina*	*Acanthacaeae*	Low risk
Api-api	*Avicenia lanata*	*Acanthacaeae*	Susceptible
Bogem	*Sonneratia alba*	*Lythraceae*	Low risk
Gedabu	*Soneratia ovata*	*Lythraceae*	Near Threatened
Bakau Minyak	*Rhizophora apiculata*	*Rhizophoraceae*	Low risk
Bakau hijau	*Rhizophora mucronata*	*Rhizophoraceae*	Low risk
Bakau merah	*Rhizophora stylosa*	*Rhizophoraceae*	Low risk
Pisang-pisang	*Kandelia candel*	*Rhizophoraceae*	Low risk
Bakau hitam	*Bruguiera gymnorhiza*	*Rhizophoraceae*	Low risk
Bakau putih	*Bruguiera cylindrika*	*Rhizophoraceae*	Low risk
Buta-buta	*Exoecaria agallocha*	*Euphorbiaceae*	Low risk
Nipah	*Nypa fruticans*	*Aracaceae*	Low risk

Source : primary data

Mangrove type that found such as Avicenia lanata and Soneratia ovata included in the list of International Union for Conservation (IUCN) with conservation status of vulnerable and almost threatened. Conservation status is indicator that used to know the existence of a type in this world, how much risk of that

type will be extinct in the future. Structure and ecosystem pattern of mangrove were different in each station. Station 1 in the coordinat0”15’54”N, 109”4’1”E was found that:

Table 3. Importance Value Index Station I

Species	n	K (individu/m^2)	KR (%)	F	FR (%)	D (cm^2/m^2)	DR (%)	INP (%)
Seedling								
Avicennia lanata	28	28	40,58	1,00	30,00			70,58
Rhizophora stylosa	30	30	43,48	1,00	30,00			73,48
Rhizopora apiculata	5	5	7,25	0,67	20,00			27,25
Nypa frutican	6	6	8,70	0,67	20,00			28,70
Total	69	69	100,00	3,33	100,00			200,00
Sapling								
Avicennia lanata	27	1,080	49,09	1,00	30,00			79,09
Rhizophora stylosa	21	0,840	38,18	1,00	30,00			68,18
Rhizopora apiculata	6	0,240	10,91	0,67	20,00			30,91
Nypa frutican	1	0,040	1,82	0,67	20,00			21,82
Total	55	2,20	100,00	3,33	100,00			200,00
Tree								
Avicennia lanata	28	0,280	37,33	1,00	30,00	78,91	34,19	101,53
Rhizophora stylosa	29	0,290	38,67	1,00	30,00	106,75	46,26	114,92
Rhizopora apiculata	11	0,110	14,67	0,67	20,00	33,81	14,65	49,32
Nypa frutican	7	0,070	9,33	0,67	20,00	11,32	4,90	34,24
Total	75	0,75	100,00	3,33	100,00	230,79	100,00	300,00

Station 2 in the coordinate 0”18’05”N, 109”00’28”E was found:

Table 4. Importance Value Index Station II

Species	n	K (individu/m^2)	KR (%)	F	FR (%)	D (cm^2/m^2)	DR (%)	INP (%)
Seedling								
Avicennia lanata	22	22,00	43,14	1,00	33,33			76,47
Rhizopora apiculata	15	15,00	29,41	1,00	33,33			62,75
Kandelia candel	2	2,00	3,92	0,33	11,11			15,03
Exoecaria agallocha	12	12,00	23,53	0,67	22,22			45,75
Total	51	51,00	100,00	3,00	100,00			200,00
Sapling								
Avicennia lanata	12	0,48	33,33	0,67	28,57			61,90
Rhizopora apiculata	11	0,44	30,56	1,00	42,86			73,41
Exoecaria agallocha	13	0,52	36,11	0,67	28,57			64,68
Total	36	1,44	100,00	2,33	100,00			200,00
Tree								
Avicennia lanata	8	0,08	34,78	0,67	33,33	51,16	55,07	123,19
Rhizopora apiculata	3	0,03	13,04	0,67	33,33	18,63	20,06	66,43
Exoecaria agallocha	12	0,12	52,17	0,67	33,33	23,11	24,87	110,38
Total	23	0,230	100,00	2,00	100,00	92,90	100,00	300,00

Station 3 in the coordinate 0”22’20”N, 108”56’31”E was found

Table 5. Importance Value Index Station III

Species	n	K (individu/m^2)	KR (%)	F	F (%)	D (cm^2/m^2)	DR (%)	INP (%)
Seedling								
Avicennia marina	28	28,00	62,22	1,00	50,00			112,22
Avicennia lanata	11	11,00	24,44	0,67	33,33			57,78
Exoecaria agallocha	6	6,00	13,33	0,33	16,67			30,00
Total	45	45,00	100,00	2,00	100,00			200,00
Sapling								
Avicennia marina	30	1,20	52,63	1,00	50,00			102,63
Avicennia lanata	20	0,80	35,09	0,67	33,33			68,42
Exoecaria agallocha	7	0,28	12,28	0,33	16,67			28,95
Total	57	2,28	100,00	2,00	100,00			200,00
Tree								
Avicennia marina	34	0,34	48,57	1,00	50,00	87,53	46,15	144,72
Avicennia lanata	26	0,26	37,14	0,67	33,33	70,14	36,98	107,46
Exoecaria agallocha	10	0,10	14,29	0,33	16,67	31,99	16,87	47,82
Total	70	0,70	100,00	2,00	100,00	189,65	100,00	300,00

Station 4 in the coordinate 0”28’11”N, 108”108’9”E was found:

Table 6. Importance Value Index Station IV

Species	n	K (individu/m^2)	KR (%)	F	F (%)	D (cm^2/m^2)	DR (%)	INP (%)
Seedling								
Avicennia marina	33	33,00	52,38	1,00	37,50			89,88
Soneratia ovata	13	13,00	20,63	0,67	25,00			45,63
Bruguiera cylindrika	10	10,00	15,87	0,67	25,00			40,87
Bruguiera gymnorhiza	7	7,00	11,11	0,33	12,50			23,61
Total	63	63,00	100,00	2,67	100,00			200,00
Sapling								
Avicennia marina	15	0,60	34,09	0,67	28,57			62,66
Soneratia ovata	13	0,52	29,55	0,67	28,57			58,12
Bruguiera cylindrika	11	0,44	25,00	0,67	28,57			53,57
Bruguiera gymnorhiza	5	0,20	11,36	0,33	14,29			25,65
Total	44	1,76	100,00	2,33	100,00			200,00
Tree								
Avicennia marina	3	0,03	16,67	0,33	16,67	14,14	45,81	79,15
Soneratia ovata	6	0,06	33,33	0,67	33,33	6,58	21,33	88,00
Bruguiera cylindrika	5	0,05	27,78	0,67	33,33	5,99	19,40	80,51
Bruguiera gymnorhiza	4	0,04	22,22	0,33	16,67	4,15	13,46	52,35
Total	18	0,18	100,00	2,00	100,00	30,86	100,00	300,00

Station 5 in the coordinate 0”29’29”N, 108”51’42”E was found:

Table 7. Importance Value Index Station V

Species	n	K (individu/m^2)	KR (%)	F	F (%)	D (cm^2/m^2)	DR (%)	INP (%)
Seedling								
Rhizophora mucronata	16	16	35,56	1,00	30,00			65,56
Bruguera gymnorhiza	15	15	33,33	1,00	30,00			63,33
Soneratia ovata	2	2	4,44	0,33	10,00			14,44
Exoecaria agallocha	8	8	17,78	0,67	20,00			37,78
Nypa fruticans	4	4	8,89	0,33	10,00			18,89
Avicenia alba	0	0	0,00	0,00	0,00			0,00
Total	45	45	100,00	3,33	100,00			200,00
Sapling								
Avicenia alba	5	0,20	7,94	0,67	14,29			22,22
Avicenia marina	2	0,08	3,17	0,33	7,14			10,32
Soneratia alba	2	0,08	3,17	0,33	7,14			10,32
Rhizophora mucronata	20	0,80	31,75	1,00	21,43			53,17
Bruguera gymnorhiza	15	0,60	23,81	1,00	21,43			45,24
Soneratia ovata	3	0,12	4,76	0,33	7,14			11,90
Exoecaria agallocha	12	0,48	19,05	0,67	14,29			33,33
Nypa fruticans	4	0,16	6,35	0,33	7,14			13,49
Total	63	2,52	100,00	4,67	100,00			200,00
Tree								
Avicenia alba	6	0,06	11,11	0,67	14,29	10,21	6,23	31,62
Avicenia marina	2	0,02	3,70	0,33	7,14	5,49	3,35	14,20
Soneratia alba	2	0,02	3,70	0,33	7,14	5,67	3,46	14,30
Rhizophora mucronata	15	0,15	27,78	1,00	21,43	57,08	34,82	84,02
Bruguera gymnorhiza	13	0,13	24,07	1,00	21,43	34,71	21,17	66,67
Soneratia ovata	3	0,03	5,56	0,33	7,14	12,63	7,70	20,40
Exoecaria agallocha	11	0,11	20,37	0,67	14,29	35,16	21,45	56,10
Nypa fruticans	2	0,02	3,70	0,33	7,14	3,00	1,83	12,68
Total	54	0,54	100,00	4,67	100,00	163,96	100,00	300,00

4. CONCLUSION

Through the research result of mangrove structure and distribution in Mempawah Regency, West Kalimantan Province, thus it could be known that in 2014 mangrove area was 739.31 Ha which comprised of 13 types of Avicennia alba, Avicennia marina, Avicenia lanata, Sonneratia alba, Soneratia ovata, Rhizophora mucronata, Rhizophora stylosa, Kandelia candel, Bruguiera gymnorhiza, Bruguiera cylindrika, Exoecaria agallocha, Nypa fruticans where for mangrove type that found such as Avicenia lanata and Soneratia ovata included in the list of International Union for Conservation (IUCN) with conservation status of vulnerable and almost threatened.

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