Asian Journal of Applied Sciences (ISSN: 2321 – 0893)
Volume 03 – Issue 05, October 2015

Reflectance Characteristic of Mangrove Species using Spectroradiometer HR-1024 in Suppa Coast, Pinrang, South Sulawesi, Indonesia

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ABSTRACT--- ***This study was conducted in coastal Suppa, Pinrang, South Sulawesi, Indonesia. Objectives of the study is to know the reflectance of mangrove species the spectrum of visible light the wavelength region of 400-700 nm and near infrared (NIR) (700-900 nm). Four species of mangrove is Avicennia marina, Rhizophora apiculata, Rhizophora mucronata and Sonneratia alba. Reflectance values are obtained by using a Spectroradiometer HR-1024. In the region of the visible light spectrum the blue wavelengths (400-500 nm), green (500-600 nm) and red (600-700 nm) showed that the highest reflectance value indicated by Rhizophora apiculata with each reflectance value respectively 5.42 %, 15.29 %, and 16.25 %. Meanwhile the value of reflectance the NIR wavelength region (700-900 nm), which is the highest indicated by Rhizophora mucronata with a reflectance value of 85.67%. Understanding karakterisitk reflectance various species of mangrove are very important in order to manage the mangrove ecosystem.***

Keywords--- Reflectance; species of mangrove; visible light; near infrared (NIR); Spectroradiometer HR 1024

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1. INTRODUCTION

Generally mangroves is a typical species found in areas of tidal and sub-tropical regions around the world. Mangroves form a habitat for many species of flora and fauna, with high density (Murray et al. 2003; Sheridan & Hays, 2003; Liu et al. 2008; Nagelkerken et al., 2008). Mangroves are also important to humans for many reasons, including fisheries, agriculture, forestry, building material resources, protection against coastal erosion and hurricanes, the absorption of pollutants, and to support coastal fisheries (Hogarth 1999; Manson et al. 2005; Walters et al . 2008; Howari et al., 2009).

Throughout the world, the loss of mangroves have been significantly influential in recent decades, although in some areas of mangroves in the world is still a very large forest (Spalding 1998; Alongi 2002). Knowledge to obtain information about the mangrove ecosystem is very important especially in the case of mapping to track the rate of change and degradation. Remote sensing technology is a potential approach for the fast and efficient management of mangrove (Held et al. 2003). This statement is highly supported by the large number of remote sensing applications research works, especially in the provision of resources mangroves and mangrove change detection (Berlanga-Robles and Ruiz-Luna 2002, and Manson et al. 2003), including research on mangrove mapping and monitoring using multispectral sensors and hyperspektrum (Demuro and Chisholm, 2003; Held et al. 2003; Hirano et al 2003).

According to Green et al. (2000), the three main objectives of remote sensing applications for mangrove management namely: (i) mangrove resources, (ii) change detection, and (iii) selection and inventory of farms. Identification and classification of features of various species of plants from remote sensing requires an understanding of the nature and features of the response spectrum in different parts of the electromagnetic spectrum region. Lillesand and Kiefer (2000) states, when it electromagnetic energy in appearance on earth, there are three possible trees with the incident energy of interaction. Applying the principle of conservation of energy, we can declare the third relationship is the interaction energy can be formulated as follow:

E1 = ER (λ) + EA (λ) + ET (λ)
where:
E1 = energy of incident
ER = energy reflected
EA = energy absorbed
ET = energy transmitted
λ = all components of the energy is a function of wavelength

There are two important things from that relationship. First the proportion of energy reflected, absorbed and transmitted to the different features of the land, which also varies, because depending on the type and condition of the feature. The proportion of this energy that allows researchers to recognize the characteristics of the earth in the picture. Second the dependence on wavelength, that although the earth's surface features and shape features of a similar but different proportions of energy at the different wavelengths.

Smith (2012), stating the spectral reflectance of different materials, can be measured in the laboratory or in the field, which can be used to interpret the image as reference data. For example the illustration below shows the reflectance spectra curves for the three natural materials which are very common: dry soil, green vegetation, and water. Reflectance of dry soil visible through infrared rise uniformly and close wavelength range peaking in the middle infrared range. It shows the lowest price is only small in the medium infrared range due to absorption by clay minerals. Green vegetation has a very different spectrum. Reflectance of visible range is relatively low but the green light is higher than the blue and red light. The pattern of green vegetation reflectance in the visible wavelengths is because selective absorption by chlorophyll the main photosynthetic pigment in green plants. Infrared radiation penetrates the plant's leaves and intense scattered by complex internal structure of the leaf so that the high reflectivity (Figure 1).

Knowledge of the spectrum of reactions from an object and materials form the basis to determine the characteristics of objects and materials. Research using Spectroradiometer SVC HR-24 provides the option of selecting a specific bandwidth or wavelength spectrum to distinguish various species of mangrove plants.

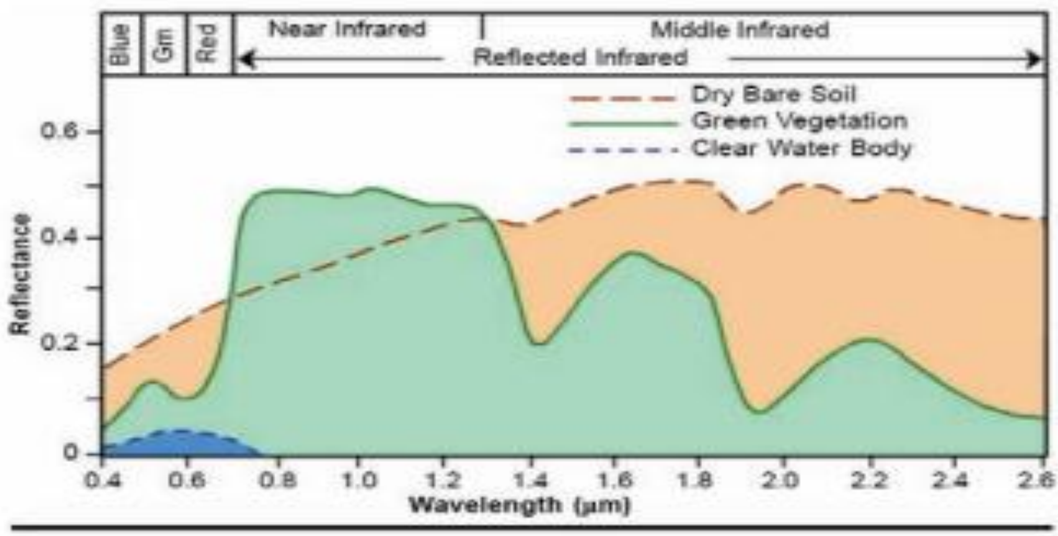

Figure 1. Spectral reflectance curve (Smith, 2001b)

2. DATA AND METHODOLOGY

Reflectance measurements of mangrove species, in do at Suppa coast, Indonesia using Spectroradiometer SVC HR-24. Mangrove species is selected *Avicennia marina*, *Rhzophora mucronata*, *Rhizophora apiculata* and *Sonneratia alba*. For every species of mangrove do ten repetitions with different trees. At the time of data collection the distance between mangrove leaves with Spectroradiometer SVC HR-24 is ± 0.5 m. When high mangrove trees whose leafy branches cut, and directly measured, to maintain the purity of the quality of the leaf. Reflectance data were measured in open area, with excellent weather conditions, bright sun and cloudless.

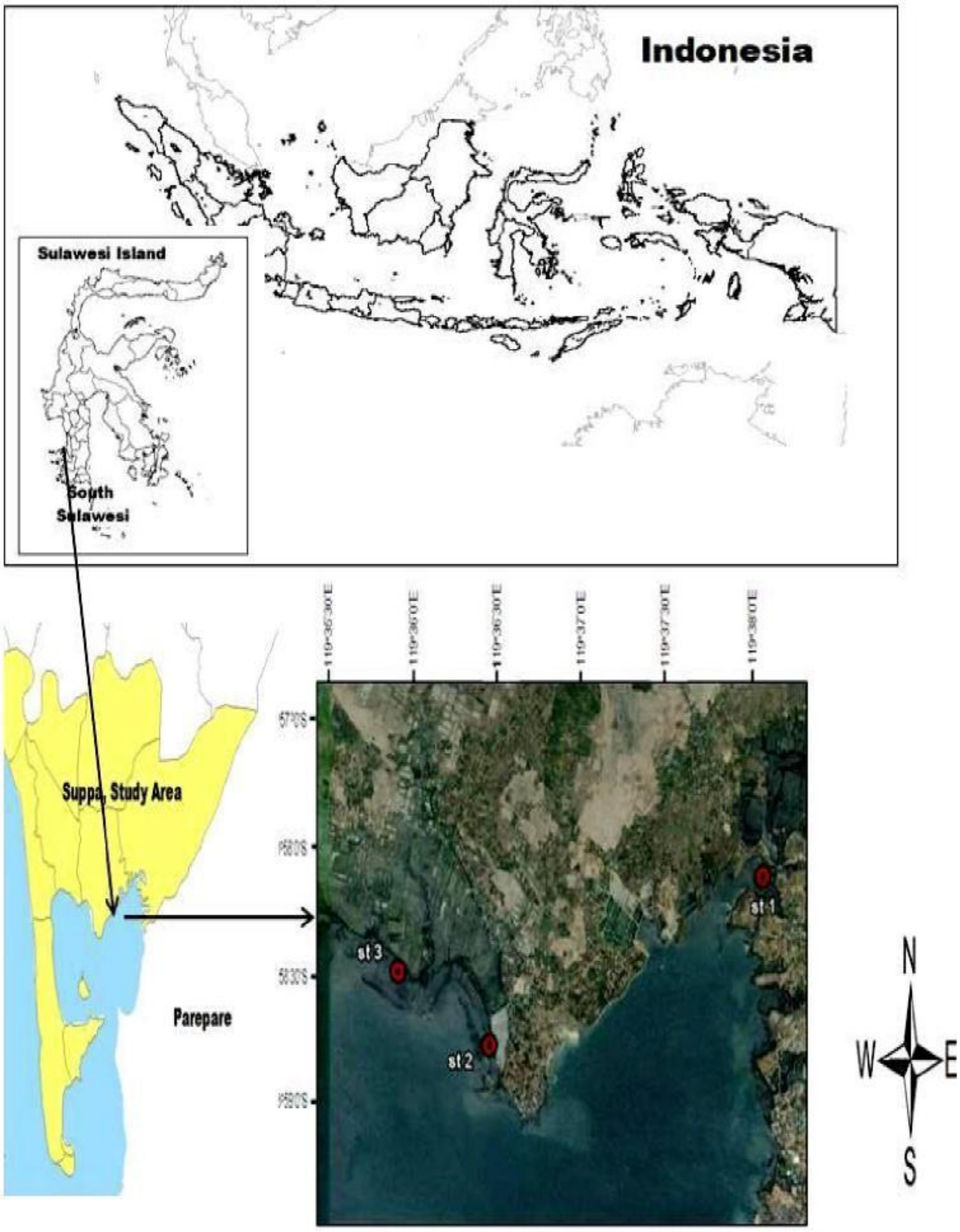

Figure 2. Location of study

Figure 3. mangrove species

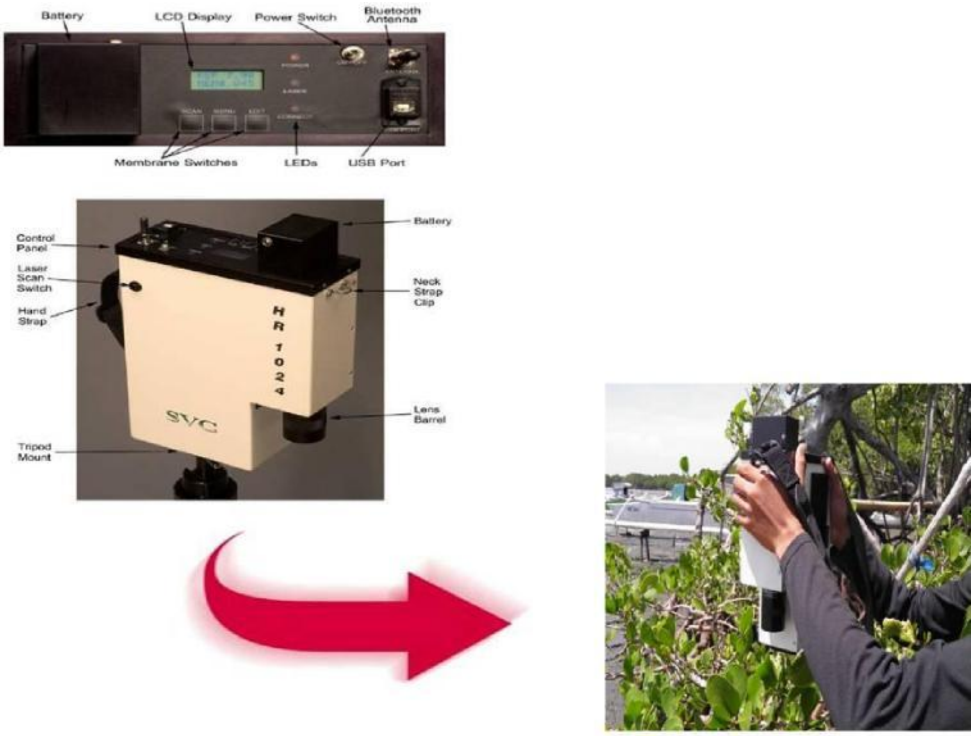

Figure 4. Spectroradiometer HR-1024

3. DATA ANALYSIS

All data which obtained, in the analysis by using the "SVC HR-1024 Data Acquisition Software V 1.0". This software the data can process a maximum of 60 per time with the function of the internal building graphics. Average reading reflectivity response the four species of mangrove is calculated based on the number of replicates of each of the mangrove leaves. Value of the average reflectance spectrum is used to form the reflection curve. Fourth reflectance curves are combined into a single graphic to develop a relationship or difference between mangrove species.

4. RESULTS AND DISCUSSION

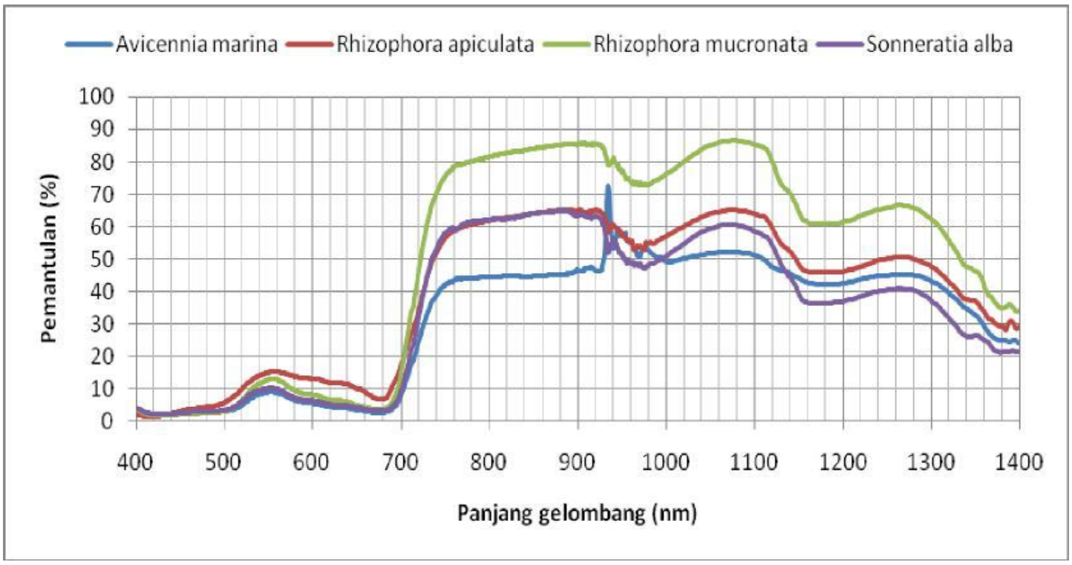

Figure 5. Reflectance of mangrove species

Figure 5 shows the pattern of reflectance comparison between mangrove species at all wavelengths. Generally all four species of mangrove have the same contour shape. The amplitude of the spectral reflectance varies based on the types of mangrove. In the blue wavelength region (400-500 nm), *Rhizophora apiculata* has the highest reflectance value of 5.42%, then *Sonneratia alba*, *Avicennia marina* and *Rhizophora mucronata*, with each value reflektasi 13. 08%, 10.17% and 9.01%. In the blue wavelength region showed that of all species do not have a clear pattern of peaks. Red wavelength region (500-600 nm), the highest reflectance value, indicated by *Rhizophora apiculata* (15.29%) then *Rhizophora mucronata* (13.08%), *Sonneratia alba* (10.17%) and *Avicennia mari*na (9.01%). For the green wavelength region (600-700 nm), the highest reflectance value, indicated by *Rhizophora apiculata* (16.25%), *Rhizophora mucronata* (12.99%), *Sonneratia alba* (8.30%) and *Avicennia marina* (7.03%). In the region of visible wavelengths visible low reflectance values obtained. This is because the high absorption of each species of mangroves as the effects of the high content of chlorophyll. Effect of low reflectance also showed that in the research area of mangrove leaves in a healthy condition (Sutanto, 1986). The results of this study also consistent with previous research conducted Matang Forest Preserve in Malaysia the use of the mangrove species *Rhizophora apiculata* , *Rhizophora mucronata*, *Acrostichum speciosum* and *Acrostichum aureum* (Chun, et al., 2011).

In the NIR wavelength region the highest reflektasi value indicated by *Rhizophora mucronata* (85.67%), and *Rhizophora apiculata* (65.26%), *Sonneratia alba* (64.76%) and *Avicennia mari*na (46.60%). Contrast to reflectance values in the region of the visible (400-700 nm) is low, in the NIR region (700-900 nm) reflectance values obtained high this may be caused by the structure of the leaves and leaf phonological phase, as well as many spectrum (radiation) scattered in leaf structure which is reflected back through the leaf surface with the same proportion is transmitted back through the leaves thus contributing to the high reflectance values in the mangrove leaves in the NIR region (Leeuwen and Huete, 1996). Curran reports (1985) that pigmentation canopy structure and leaves have an effect on the absorption reflectance and transmittance. Wavelength region of 900 - 1400 nm were excluded from the analysis because the results of noisy readings. This due to fluctuations in the light source of the sun changes in cloud cover and atmospheric conditions. The higher the value of reflection in the NIR part of the spectrum perhaps due to the internal structure of the mangrove leaves and phonological stages (Leeuwen and Huete, 1996). In addition, many of the scattered wavelength the structure of the leaf will be reflected back through the leaf surface with the same proportion and transmitted through the leaves and this contributes, to the high reflectance values in mangrove leaves in the NIR region.

Other factors which affects differences in reflectance of each mangrove species is the change in cloud cover, and atmospheric conditions, because in this study data collection was not possible to do the same as well as the spectral properties of mangrove plants varies spatially and temporally at the level canopy (Peerzada and Rohoza, 1989).

5. CONCLUSION

This study provides an overview, of the reflectance characteristics, the four species of mangrove are selected is *Avicennia marina*, *Rhizophora apiculata*, *Rhizophora mucronata*, and *Sonneratia alba* in coastal Suppa, Pinrang, South Sulawesi. The results obtained showed that, every species of mangrove have a reflectance response which is unique and special, where in the region of the visible light spectrum the blue wavelengths (400-500 nm), green (500-600 nm), and red (600 - 700 nm), showed that, the highest reflectance value, indicated by *Rhizophora apiculata* with reflectance values respectively 5.42%, 15.29%, and 16.25%. Meanwhile the value of reflectance, the NIR wavelength region (700-900 nm) which is the highest indicated by *Rhizophora mucronata* with a reflectance value of 85.67%. Furthermore, this study can be used to distinguish wavelength identifier in distinguishing reflection Janis mangrove species based on discriminant statistical analysis.

6. ACKNOWLEDGEMENTS

Special thanks to the Governor of South Sulawesi which has provided assistance studies. Also the Earth Observation Centre The Centre of Excellence faculty of Social Science and Humanities, Universiti Kebangsaan Malaysia which have been lend Spectroradiometer HR-1024 instrument.

7. REFERENCES

- Alongi, D.M. 2002. Present state and future of the world’s mangrove forests. Environ. Conserv, 29:331-349.
- Berlanga-Robles, C.A. & Ruiz-Luna, A. 2002. Land use mapping and change detection in the coastal zone of northwest Mexico using remote sensing techniques. *Journal of Coastal Research* 18, 514-522.
- Chun, B.B Mohd. Zubir Mat Jafri & Lim Hwee San. 2011. Reflectance Characteristic of Certain MangroveSpecies at Matang Mangrove Forest Reserve,Malaysia. Proceeding of the 2011 IEEE International Conference on Space Science and Communication (IconSpace) 12-13 July 2011, Penang, Malaysia.
- Curran, P.J. 1985. Principles of remote sensing, Longman, New York. pp. 23-30.
- Demuro, M., Chisholm, L. 2003. Assessment of Hyperion for characterizing mangrove communities. Proceedings of the International Conference the AVIRIS 2003 workshop: 18-23.
- Green, E.P., Clark, C.D., Edwards, A.J. 2000. Image classification and habitat mapping. In: Remote Sensing Handbook for Tropical Coastal Management. UNESCO, Paris, pp. 141-154
- Held, A., Ticehurst, C., Lymburner, L. & Williams, N. 2003. High resolution mapping of tropical mangrove ecosystems using hyperspectral and radar remote sensing. *International Journal of Remote Sensing* 24, 2739-2759.
- Hirano, A., Madden, M., Welch, R. 2003. Hyperspectral image data for mapping wetland vegetation. Wetlands 23, 436-448.
- Hogart, P.J. 1999. The Biology of Mangroves. Oxford University Press, New York.
- Howari, F. M., Jordan, B. R., Bouhounce, N. & Wyllie-Echeverria, S. 2009. Field and remote-sensing assessment of mangrove forests and seagrass beds in the Northwestern Part of the United Arab Emirates. *Journal of Coastal Research*, *25*(1), 48-56.
- Leeuwen, W.J.D, and A. R. Huete. 1996. “Effect of standing litter on the biophysical Interpretation of plant canopies with spectral indices,” Remote sensing of Environment, 55, pp. 123–138.
- Lillesand, T.M., Kiefer, R.W. 2000. Remote sensing and image interpretation. Jhon Wiley, Chichester. New York
- Liu, K. & Li, X. 2008. Monitoring mangrove forest changes using remote sensing and GIS data with decision-tree learning wetlands. *The Society of Wetland Scientists*, *28*(2), 336–346

- Manson, F.J., Loneragan, N.R. & Phinn, S.R. 2003. Spatial and temporal variation in distribution of mangroves in Moreton Bay, subtropical Australia: a comparison of pattern metrics and change detection analysesbased on aerial photographs. *Estuarine, Coastal and Shelf Science* 57, 653-666

- Murray, M. R., Zisman, S. A., Furley, P. A., Munro, D. M., Gibson, J. & Ratter, J., *et al.* 2003. The mangroves of Belize Part 1. Distribution, composition and classification. *Forest Ecology and Management, 174*(1-3), 265–279.

- Nagelkerken, I., Blaber, S. J. M., Bouillon, S., Green, P., Haywood, M. & Kirton, L. G. 2008. The habitat function of mangroves for terrestrial and marine fauna: A review. *Aquatic Botany*, *89*, 155–185.

- Peerzada, N. & W. Rohoza. 1989. Some heavy metals in sediments from Darwin Harbour Australia. Mar. Poll. Bull., 20, 91-92

- Sheridan, P. & Hays, C. 2003. Are mangroves nursery habitat for transient fishes and decapods *Wetlands*, *23*(2), 449–458.

- Smith, R, B. 2012. Introduction to Remote Sensing of Environmental (RSE). TNT mips.

- Smith, R, B. 2001b. Introduction to remote sensing of the environment. www.microimages.com (Accessed 24/03/2006)

- Sutanto. 1986. Penginderaan Jauh, Jilid 1 dan 2, Gadjah Mada University Press. Yogyakarta

- Spalding, M.D. 1998. *Patterns of biodiversity in coral reefs and mangroves: global and local scales.* Ph.D. Thesis. University of Cambridge, U.K.

- Walters, B.B., Ro"nnba"ck, P., Kovacs, J.M., Crona, B., Hussain, S.A., Badola, R., Primavera, J.H., Barbier, E. & Dahdouh-Guebas, F. 2008. *Ethnobiology, socio-economics and management of mangrove forests: A review*. Aquat. Bot. 89, 220-236.