Remote Sensing and GIS approach in assessment and conservation of Seagrass Beds in the coastal stretch along Gulf of Mannar

M.Naveenan[1*], D.D.D.Weragodatenna[2], A.B.A.K.Gunaratne[2], R.M.C.W.M. Rathnayake[1] and S.C. Jayamanne[1]

[1]*Uva Wellassa University, Badulla, Sri Lanka*

[2]*National Aquatic Resources Research and Development Agency, Crow Island, Sri Lanka*

Abstract

Seagrasses perform multiple functions for the marine environment. They not only provide beneficial ecological services to the environment, but also for coastal human population. However, increasing anthropogenic activities in coastal environment has leaded this valuable resource to face depletion. The continuous loss of seagrass will lead to adverse effects on the marine ecosystems, and therefore, conservation of this aquatic flora is important. Although Sri Lanka has a rich diversity of coastal ecosystems including seagrass, there is little information on spatial distribution of seagrass communities. Therefore, this study integrates remote sensing and Geographic Information Systems (GIS) to assess the distribution of seagrass in the coastal stretch of Gulf of Mannar, extending from Kudiramalai point to Mannar town. The high resolution imagery of IKONOS was used as the base source. The satellite image was subjected to pre-processing. Supervised and unsupervised classification methods were performed in order to select the most suitable classification method for underwater habitat extraction. Accuracy assessment was done using error matrix method. Results showed that unsupervised classification provided 75% overall accuracy. Based on the results obtained, the seagrass coverage of the study area was estimated at about 1209.6 hectares, which is about 10.87%.

Keywords: Remote Sensing, Gulf of Mannar, IKONOS, seagrass, GIS

**Corresponding author: mnaveenan@gmail.com*

Introduction

Seagrasses are a group of aquatic angiosperms that make a vital contribution to the associated ecosystems as well as humans. Seagrasses provide many benefits not only for the coastal environment but also for fishing communities. This valuable natural resource is facing destruction mainly due to anthropogenic activities. There is very little information on the geographic distribution of seagrass communities in Sri Lanka (De Silva and Ranatunga, 1987). Seagrass communities have been recorded mainly near Batticaloa, Trincomalee, Mannar, Hikkaduwa, Negombo and Puttalam (Mathiventhan and Jayasingam, 2004). Although, several attempts have been made to identify the seagrass species present in some coastal waters of Sri Lanka, there is a necessity for further studies. The use of remote sensing and Geographic Information

Systems (GIS) is highly effective in conducting studies on seagrass. However, the application of remote sensing is still a novel approach for studies in Sri Lanka. The Gulf of Mannar is a region having a rich biodiversity with over 3000 species of fauna and flora including seagrass (IUCN, 2010). Several studies on seagrass mapping have been carried out continuously in the Gulf of Mannar by Indian scientists (Mathews *et al.* 2008; Sulochanan *et al.* 2010) but there is a necessity for further studies in Sri Lankan waters. Therefore, this study was carried out to map and quantify the seagrass distribution in a part of Gulf of Mannar by using remote sensing and GIS technology.

Materials and Methods

The study area extends 2 km from the shoreline towards the sea from Kudiramalai point to Mannar town. IKONOS satellite images (multispectral image with 4 m spatial resolution and panchromatic image with 1 m spatial resolution) obtained in 2005 was used as the base data. The satellite images were subjected to pre-processing using ERDAS Imagine that included layer stacking, resolution merge, geometric, radiometric (using ENVI software) and atmospheric corrections, masking and several image enhancement techniques. Supervised and unsupervised classifications were performed to extract the seagrass features. Field data which was collected previously in 2008 by NARA was used for the supervised classification. Based on results of accuracy assessment the mapping of seagrass distribution was performed. Finally, the extent of seagrass cover present in the study site was calculated.

Results and Discussion

Image enhancement proved that the band combination of 3,2,1 (red, green and blue respectively) provided better visualization of seagrass. Furthermore, it was found that edge enhancement technique in ERDAS increased brightness, contrast and sharpness which is the most suitable image enhancement technique for visualization.

Unsupervised classification was performed using 20 classes without prior knowledge of the field. Then it was merged into the most relevant classes (seagrass, coral reef and sand) for this study. Supervised classification was performed using ground truth data previously obtained by NARA.

Accuracy assessment was performed by confusion matrix method using ground truth data obtained by NARA in 2008. A total of 12 ground points were used for the accuracy assessment. Overall accuracy of unsupervised classification was 75% while supervised classification showed 58%. Usually, supervised classification is considered more accurate for mapping classes but it highly depends on the skills and cognition of the image specialist. During this study it was not possible to go to the field to collect ground data due to occurrence of rough sea. Since unsupervised classification provided higher overall accuracy than supervised classification it was used for the final mapping of seagrass distribution.

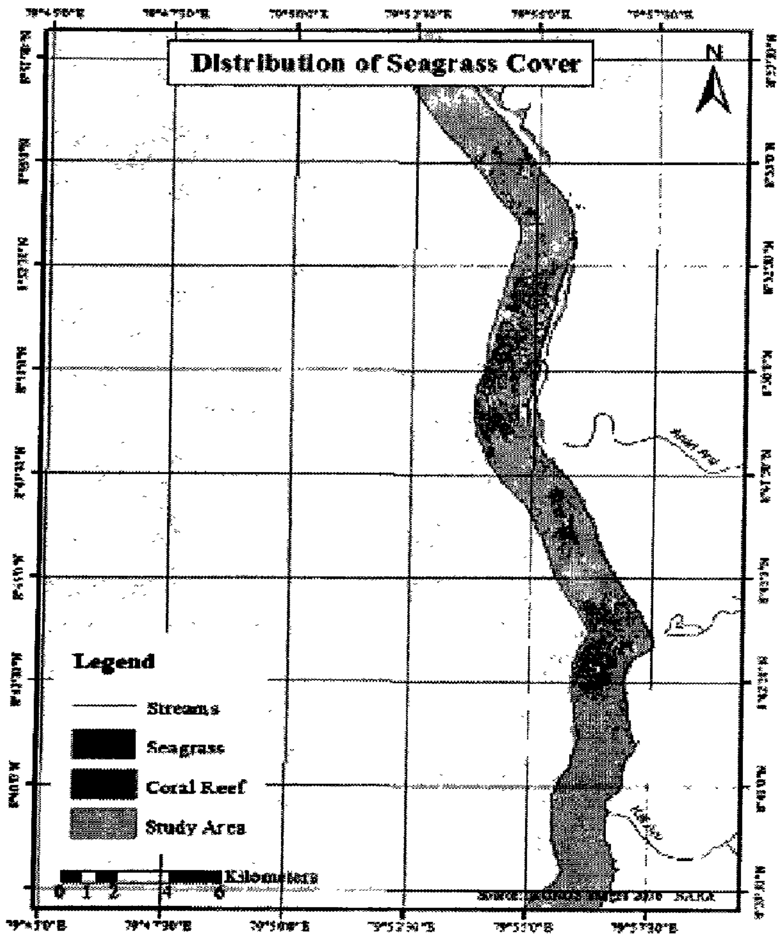

Figure 1: Final map of seagrass distribution in study area

As shown in Figure 1, the seagrass exist as dense beds as well as patches with less density. Although, sedimentation effect from rivers is considered as unfavourable for seagrass survival, dense seagrass beds can be found close to the river mouth of Aruvi (also known as Malwathu river). The reason for this is due to low sediment accumulation at the mouth of this river. According to the analysis the total extent of seagrass in the study area was about 1209.6 ha. Hence, seagrass cover is 10.87% of the study area. The pollution, boating and sedimentation were considered as possible threats to seagrass in the study region during previous field visits by NARA (2012).

Conclusion

The seagrass covers an extent of 10.87% of the study area. Unsupervised classification provided an overall accuracy of 75% against 58% from supervised classification. Sri Lanka has a responsibility towards conserving this valuable natural resource. Conservation of seagrass beds in Sri Lankan waters has not yet been addressed to any acceptable levels. Several suggestions can be made for conserving the seagrass in Gulf of Mannar, such as restriction of destructive fishing methods, rehabilitation of degraded seagrass and regulation of harmful discharges to coastal waters. Furthermore, there is a necessity for more studies in future to map the seagrass distribution in Sri Lankan waters.

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