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SOME OBSERVATIONS ON REMOTE SENSING OF TROPICAL ENVIRONMENTS

KAMLESH LULLA

Indiana State University
Remote Sensing Laboratory
Terre Haute, Indiana

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ABSTRACT

Concern for the rapid deterioration of tropical environments and ecosystems in developing countries has been mounting because of the pivotal role played by the tropical vegetative cover in the global ecology and habitability. Reports of some recent projections forecast a rapid decline in areal extent of the global vegetative cover. This depletion and deforestation is of dangerous magnitudes in the tropical zones and has been shown to vary from 0.4-2.0% of the total area of the tropics per year. Characteristically, the developing tropical nations lack adequate information about their natural and man-manipulated environments and ecosystems. This paper examines the role of satellite and microwave remote sensing in the inventorying of tropical ecosystems. The major objectives of this paper are: (a) to assess the current sensors (especially the Landsat series) for their applicability to tropical vegetative cover information and (b) to analyze the potential of other sensing systems such as meteorological satellites and microwave systems for applications in tropical environments.

Major reports dealing with remote sensing for developing tropical nations were analyzed and studied. Also, a concise review of the literature pertinent to this topic was conducted.

Assessment of Landsat based applications indicated that 60 to 70 percent accuracy of crop identification could be achieved in the developing nations. This is inadequate for acreage estimation for tropical terrestrial crop cover. The 30 meter resolution Thematic Mapper (TM) data should improve this aspect of tropical inventory but at an increased cost. Monitoring of major vegetational changes is feasible using Landsat data, but a true vegetation type inventory cannot be conducted. Preliminary evidence indicates that the potential of meteorological satellites should be further investigated for monitoring macro vegetational changes. Some experimental vegetation index products from the NOAA/AVHRR data have been reported to show some promise for global vegetative change detection. Evaluations of TM data for this application need to be done. A generalized inventory of tropical forests can be done with reasonable accuracy using Landsat data. Larger areas of forest depletion can be located and identified, but this data is inadequate for an inventory of tree species or detailed ecological groupings and associations. Forest cover changes were monitored in Sri Lanka (Ceylon) using Landsat satellite image interpretation techniques. Authorities of Sri Lanka found that Landsat imagery enabled them to map the forest cover changes quite accurately at the regional level. In 1981, a new forest cover map was compiled at the scale of 1:500,000 using Landsat and air photo coverage. This new map revealed that Sri Lanka had lost roughly 50% of the nation's forest cover between 1956 and 1979. Vegetational studies in Central Africa using Meteosat data yielded useful information on the transition patterns in rain forest - savanna ecotones. The areal extent of rain forest and humid savanna could be determined from these data. Several ecological categories within the vegetative cover such as moist woodland and savanna could be delineated using visible and thermal infrared bands. Although, Meteosat is not an ideal sensing system for land cover studies its value is immense because it is the only satellite capable of providing visible and thermal infrared digital data. The role of TM data is not yet fully documented in this area of application. The inventory of ecological factors and processes related to the vegetative cover of tropical areas is vital to understand the dynamics of tropical vegetative cover. Landsat data are not adequate for detailed assessment of these processes. Some success with microwave remote sensing techniques has been demonstrated, but their applicability to larger areas remains to be determined through additional research.

Several studies have documented the utility of Landsat data for irrigation and water management patterns in tropical cropland areas. Single date Landsat data were found to be useful for delineation of areas irrigated by surface water from those areas irrigated with ground water. Especially, in areas of Southeast Asia, where much of crop vegetative cover and natural vegetative cover depends upon monsoonal precipitation. The ability to monitor and quantify the water budgets is vitally important. Particularly in monsoon dominated areas, the nature of precipitation can produce vegetation gaps. Although, the present Landsat capabilities are useful, improved assessments with the TM and microwave data are likely to prove necessary for

inventorying the tropical water budgets and their impact on vegetative cover. A working group of a recent meeting on Remote Sensing for Tropical Rice Production concluded that a complete inventory of all water related parameters is essential. This group also indicated that improved sensors would greatly assist in optimizing water use and in designing efficient irrigation systems for tropical cropland management. Soil moisture parameters are closely associated with the regional water budgets. Efforts to detect soil moisture with remote sensors are useful in some tropical environments. The use of infrared data from Meteosat for soil moisture determination in Tropical Africa (the Sahel region) has indicated that the potential of sensors other than the Landsat series must be explored for application in tropical regions.

The inventorying of damaged and degraded tropical ecosystems has received little attention. Regional desertification studies in the African drylands have shown that Landsat sensors are sensitive for general level inventorying and change detection. The site specific analyses, so vital in such ecosystems are not feasible using Landsat data, thus the role of TM data and other improved sensor systems needs to be investigated for these ecosystems.

In short, this paper provides an assessment of the current sensor systems for tropical ecosystems and environments and established their role in the global habitability approaches.

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