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REMOTE SENSING (RES)

RES 199701 ABAN, Jose Edgardo L. (MS Remote Sensing)
Assessment and Mapping of the DENR *Cinchona* Reforestation Project Using Spectroradiometric Analyses and Digital Image Processing Techniques. 1997

Digital image processing of January 1995 SPOT satellite image data and field spectroradiometric data analyses of the *Cinchona* reforestation Project in Mt. Kaatoan, Lantapan, Bukidnon were conducted. Normalized Difference Vegetation Indices (NDVI) were derived from both satellite and field spectroradiometric samplings of *Cinchona spp.* The individual NDVI derived from field spectroradiometric sampling for the 7 *Cinchona spp.* were: *C. kartamanah* = 0.7754520, *C. succirubra* = 0.7212515, *C. calisaya* = 0.8525230, *C. officinalis* = 0.8321900, *C. hybrida* = 0.6268490, *C. ledgeriana* = 0.6464093, *C. tjinjiroena* = 0.8503721, while the average vegetation index from field spectroradiometry for the 7 *Cinchona* species only was **0.751281**. The overall computed spectroradiometric NDVI including *Cinchona*, ground litter, soil and fern (underbrush) was **0.5642324**.

The satellite derived NDVI of the *Cinchona spp.* were relatively lower than those derived from actual ground spectroradiometric samplings. The overall vegetation index computed form reflectance values from the satellite sensor was **0.56247**. A linear regression modelling was done on these two NDVIs to determine their correlation. There was poor correlation between NDVI of the satellite image data and the ground spectroradiometric data, as exemplified by a low coefficient of correlation (**r = 0.2603678**). The linear relationship between these two variables is defined by the best fit line equation, **y = 0.4910008 x + 0.3247997**.

Transect samplings, which included measurements of: tree height using the clinometric method, bark thickness, crown diameter, tree diameters at 1meter above the ground and 2 meters above the first, were done on 2 age cohorts (trees planted 1978 and 1989) of *Cinchona spp.*

Bark estimates of cohorts were made using a computer program developed, called *Tree Height.* The bark estimates and age cohorts were then fitted into 4 different models, namely Linear, Geometric, Logarithmic, and Exponential regressions, to derived at the best curve that would define the ***annual bark increment*** of the *Cinchona spp.* The annual bark increment for *Cinchona* follows a *logarithmic curve* of the form **Y = a + b log x** (where a = 2007.567, b = -2.865765). Further, the computed coefficient of correlation (**r**) was highest for the said model, having a value of **0.692039** in comparison to other models used. The regressed values derived from the geometric regression procedure were observed to be similar, but the **r** for this model was quite low (**r** = 0.2641816).

Several unsupervised and supervised classifications were done on the dataset. Estimated are harvestable based on the different classifications (unsupervised and supervised) ranged from a minimum area of **661.92 hectares** and a maximum of **953.92 hectares**, with a best estimate of **717.76** hectares based on the image ***AREAFMAX.IMG. AREAFMAX.IMG*** had the highest overall image classification accuracy of **81.82%.** These estimates were based on the classified images *AREAFRAW.IMG, AREAFMER.IMG,* and *AREAFMAX.IMG*, respectively. Subsequently, these area estimates have an estimated wet bark tonnage equivalent to **2115.3072**, **3048.755** and **2293.7559 tons**, respectively. The area estimates presented by *AREAFMUL.IMG* were most unlikely since by topology most of the areas that have been classified as not harboring *Cinchona* (e.g. natural watershed) have been classified otherwise.

Spatial intensity of *Cinchona* was not arrived at in this study since, 1) the area was harvested intermittently with no available documents; 2) the presence of *wildlings* which proliferated naturally, complicating estimation of actual tree age.

RES 199702 ABELLERA, Lourdes V. (MS Remote Sensing)
Mapping Philippine Tarsier Habitat Using Image Processing (IP) and Geographic Information Systems (GIS) Techniques.1997

The techniques of Image Processing (IP) and Geographic Information Systems (GIS) were applied to locate the habitat of the Philippine tarsier (*Tarsius syrichta*) in Dimiao and its vicinity in the Bohol province.

From published materials, it was determined that the Philippine

tarsier is found (1) between the equator and 10° North latitude, (2) where the minimum temperature is 18° Celsius, (3) where the humidity is about 80%, (4) in secondary growth forest, (5) in forest near the sea, rivers and creeks, (6) in abandoned clearings with new growths of medium-height plants at low and medium elevations, and (7) in areas one hectare and more.

These seven habitat requirement criteria (HRC) necessitated the use of a Landsat TM satellite image, a topographic map, aerial photographs, climatological normals, and the climate map of the Philippines. Utilizing the raster-based GIS software IDRISI, various IP and GIS operations were performed, particularly image classification, image rectification, reclassification, data structure conversion, spatial operations, measurement, and statistical analysis. In addition to image classification, photointerpretation and fieldwork were also conducted to determine the different land cover classes in the study area.

The habitat map, which can be used as a map of sighting potential for the Philippine tarsier, shows a habitat area of 1,428.48 hectares.

Because of speed capability for covering extensive regions, Image Processing and Geographic Information Systems techniques can complement the common methods of locating habitats (i.e. actual sightings and interview with local residents) provided that (1) the habitat requirements are known, (2) the GIS numerical quantities are available, and (3) the necessary data can be converted to digital format.

RES 199703 ASAÑA, Cary L. (MS Remote Sensing)
Design and Development of a Decision-Support System for a GIS-Based Physical Land Suitability Assessment Model. 1997

A GIS-based assessment model was developed to implement a physical land suitability evaluation following the FAO's (Food and Agriculture Organization of the United Nations) framework for land evaluation. Under this framework, the smallest spatial unit by which an assessment is made is called a land mapping unit (LMU). Each of these

mapping units is identified by a set of land characteristics, such as slope, drainage, texture, etc. These are matched against a set of requirements for a crop of interest in generating the land suitability classification (LSC),

and subsequently, in updating the spatial database of the coverage area.

Consequently, a decision-support system (DSS) was developed to facilitate the physical land suitability evaluation corresponding to the GIS-based assessment model. It was developed using FoxPro for Windows on an IBM PC and compatible platform. It is designed to enable users to input their individual assessment models conforming to the rule-based approach and relational database architecture of the DSS. A user could specify the particular land characteristics comprising his LMU, and provide his own decision criteria resolving the suitability classification.

RES 200004 BALAIS, Benjamin P. (MS Remote Sensing)
Estimating the Depths of Shallow Waters Using Landsat Thematic Mapper Data: The Case of the Kalayaan Island Group. 2000

In an effort to address the considerable lack of baseline information on the Kalayaan Island Group (KIG) in which the Philippines is the one of the claimants, this paper synthesizes the capability of some advanced technologies to provide information on the bathymetry of some unknown shallow areas. These technologies include remote sensing, geographic information system (GIS) and statistical tools to predict the depths of the shallow portion of the KIG. The study makes use of Landsat Thematic Mapper (TM) data and available nautical charts as inputs to the multiple regression analysis model to generate a bathymetric map of the study area. This paper also explores the use of other surface interpolation methods and compares the results with the regression model and the known depths.

The regression model is subjected to a number of standard statistical test. Result of the F-test shows that there is a functional dependence of depths on the independent variables (Landsat TM Band 1

signal and bottom characteristics). Analysis of the partial regression coefficients, including the standardized, indicate that depth exhibits dependency on the bottom classes that are shallower than 16 fathoms. Results show that shallow portions corresponding to classes 3 to (rock-coral, calcareous rock, rock-sand-rubble and coralline sand) are very

important in determining the depths.

RES 200305 CAMPO, Paolo C. (MS Remote Sensing)
Multi-agent Systems Modeling Integrating Geographic Information Systems and Remote Sending: Tools for Participatory Natural Resource Management (Prototype for Loon in Bohol, Philippines). 2003

This research tried to develop a methodology for building a Multi-Agents Systems simulation model integrating Geographic Information Systems and Remote Sensing for participatory natural resource management. The methodology, based on a modified conceptual framework of Pahl-Wostl (2002), involved the use of MAS, GIS, RS techniques for data collection and processing, MAS conceptual and computer modeling, and MAS model verification and validation using a participatory approach. By using MAS, GIS and RS technologies in its construction and analysis, the MAS model is hoped to be used as a learning tool for the participants of an NRM situation. Moreover, the MAS model and its results are anticipated to be used as take-off points for discussion and negotiations in participatory NRM.

One of the main outputs of this research was a working MAS simulation model for the case of the Municipality of Loon, Bohol, Philippines. To be able to build the simulation model, called the Bohol model, a two-part fieldwork in the study area was conducted by a research team, which included this researcher, to familiarize themselves with the people's perception of their current NRM situation and its problems. Also the fieldwork allowed the researchers to gather spatial information on the study area, and details about activities of the locals with regards to the use of their natural resources. All these information were processed and integrated in the MAS simulation model.

The Bohol model was only a skeleton for possible future MAS models for NRM; as of now, it does not mimic the real NRM situation. A lot of assumptions have been made such as model for fish reproduction and forest growth, to make the model run. However, based on the simulations conducted, it demonstrated how individual actions f agents collectively affected it environment. Scenarios were developed based on the initial findings of the fieldwork, and these scenarios were tested inside the Bohol

model. From the results of the simulation of the scenarios, the model was able to demonstrate the effects of changing the parameters of the model, specifically parameters related to agent behavior.

The use of spatially-explicit models, such as GIS and RS models, as learning tool offer the participants of an NRM situation a new way to see their natural resources and environment by means of digital maps. It's a way for them to see their environment from "outside the box." Through its use, the MAS models may enhance the learning experience by means of a running simulation. The participants of an NRM situation may see the MAS model simulation as a "movie" about themselves and their possible future with them being actors of this movie. Adding GIS and RS techniques to analyze the results of the simulation may add to this experience by offering ways to visualize the results of the actors' actions by means of change-detection maps, charts and cross-tabulations.

RES 200006 LIM, Maximo G. (MS Remote Sensing)
Evaluation of the Accuracy of an Airsar/Topsar Digital Elevation Model. 2000

The generation of a digital elevation model (DEM) utilizing the interferometric mode of synthetic aperture radar system (SAR) has been the subject of several studies including among others the verification of its accuracy. This study was conducted to verify the relative accuracy of a Topsar DEM data (ts0229_c_mos.demi2) taken last November 29, 1996 over the Mount Pinatubo area as part of JPL/NASA's Airsar/Topsar Pacific Rim Deployment Program. Previous Topsar DEM data evaluation studies indicated that relative errors of as low as 1-3m to as high as 11-15m are attainable.

Conversion of the raw data to physical units (in meters) was performed using the Topsar module on ENVI 3.1 image processing software then followed by georeferencing whereby four corner points provided in the DEM's header information file were registered to the WGS84 Datum and UTM projection. A reference DEM (REF1) generated digitizing NAMRIA topologic maps was used as the basis for a relative accuracy assessment. The reference DEM was counterchecked for its reliability by comparing it with a drawing file of the same area produced by PHIVOCS and was found relatively accurate with a mean residuals of 0.129m and a positive correlation coefficient of 0.9944.

Prior to the comparative analysis, the reference DEM was transformed to the same datum as the data by applying a datum shift

(Clarke1866 to WGS84) and geoidal height adjustment at each point. The datum shift of the reference DM (from Clarke1866 to WGS84) using the seven parameter Bursa-Wolfe similarity transformation formula was computed through Blue Marble Geographics' GEOGRAPHIC CALCULATOR Version 3.07. In the absence of a Philippine geoid model, geoidal height determination on a multiple-points basis was done using EGM96, a recent 15-arc minute world geoid height model developed jointly by US NASA GSFC and NIMA.

Comparative analysis was done on the difference of REF1 and TOPSAR values extracted from arbitrary transects using ENVI 3.1. Mean of the residuals are 23.217m and 20.186m for the east west and north south transects respectively with a positive correlation coefficient of 0.9023.

Errors brought about by sensor/instrument and navigation/platform configurations are considered part of the system's budget error including the tilt error as manifested by the different means of the residuals of the east-west abs north south-transects. The systematic errors are inherent to the data while the rest of the errors are attributed to the reference DEM generation (source map), the local variations in the geoidal height undulation. The exact determination of the non-system errors is beyond the scope of this study and could not be estimated in coming up with a relative accuracy assessment of the Topsar DEM.

RES 200007 NOLASCO, Joyce C. (MS Remote Sensing)
Development of a Neural Network and Fuzzy Logic-Based System for Classifying Remotely-Sensed Images. 1995

This paper presents a new procedure in detecting and classifying clusters of similar patterns. In particular, the thesis illustrates the usefulness of the procedure in the classification of land cover classes from remotely sensed data as an alternative image analysis methodology. The procedure has two components: a neural network component that handles the training, and the fuzzy engine that performs classification based on

trained classes. The network is based on the *Growing Cell Structures* (GCS) developed by Fritzke, an unsupervised learning method, that identifies spectral patterns from a training area. These spectral patterns are clusters that may indicate possible ground cover classes, the level of which may depend on the level of separability of the cluster patterns identified. Each time a new training area is evaluated by the GCS, it learns from the new training set while retaining information from the old set. Hence, new knowledge is acquired for each step. After clusters are identified by the GCS, the human expert identifies the significant land cover classes arising from the cluster analysis performed by the neural network. They are then converted to rules that govern the characteristics of the land cover classes being analyzed. The output of the conversion process serves as basis for rule generation in the fuzzy inference system.

After sufficient training has been accomplished, the system simulates the human expert knowledge and serves as an intelligent assistant to an applications expert.

RES 200108 NONAN, Allan C. (MS Remote Sensing)
Soil Erosion Mapping in the La Mesa Watershed Using Remote Sensing and Geographic Information Systems. 2001

A major problem faced by land-use planners and decision makers in the past has been the acquisition of accurate and timely information on the magnitude of land deterioration particularly in watershed areas. As a quick and modern approach to Environmental Impact Assessment (EIA), Remote Sensing (RS) and Geographic Information Systems (GIS) techniques were used in assessing soil loss in the La Mesa watershed.

In this particular study, the modified Universal Loss Equation (MUSLE) was used as a model in estimating the rate of soil loss. Soil erosion in the different portions of the study area was estimated based on the product of the factors of MUSLE; rainfall erosivity (R), soil erodibility (K), length-slope factor (LS), landcover factor (C) and conservation and management practices (P).

Thematic map layers were generated by processing and analyzing the input data of the factors of MUSLE. Two (2) sets of multi-temporal, multi-sensor satellite data were analyzed and interpreted using remote sensing software and a landcover map was produced. Likewise, four map layers consisting of R, K, LS and CP values were generated using GIS software by integrating textual or attribute data with spatial or geographic

information.

Finally, soil erosion maps were generated depicting soil loss in the different areas of the watershed. Total soil loss (in tons per year) and average soil loss (in tons per hectare per year) were estimated for different scenarios of the watershed ranging from eighty five percent (of the total watershed area) forest denudation to complete forest.

RES 199909 PARINGIT, Enrico C. (MS Remote Sensing)
Evaluation of ADEOS AVNIR Data for Land Cover Classification in the Mount Pinatubo Area. 1999

Disasters require continuous monitoring in order to thwart their potential threats to life and property. By providing periodically acquired remotely-sensed data, information on landcover change will aid planners and decision makers in planning for future land use as means to mitigate potential hazards. The Mount Pinatubo area, which is under constant threat from lahar remobilization in Central Luzon, requires such attention.

In conjunction, there is a need to develop appropriate techniques to process remotely-sensed data from new satellite payloads. The ADEOS AVNIR sensor, launched in 1997 by NASDA, is designed spatially and spectrally different with that of its predecessors. An assessment of its application potentials must be foremost undertaken.

This study sought to determine the capability of ADEOS AVNIR data for landcover classification by examining its geometric and thematic accuracy qualities. The study took special consideration of the fact that the study area is within the lahar hazard zone. Likewise, this study investigated the effects of multisensor techniques to the enhancement of landcover classification, specifically by merging JERS-1 SAR with ADEOS AVNIR by the IHS color transformation and substitution methods.

Results show that ADEOS AVNIR imagery fulfills basic geometrical requirements for landcover mapping at a convenient scale of 1:80,000. ADEOS AVNIR was effectively decorrelated by its fusion with JERS-1 SAR data, providing better perceptibility and interpretability. Standard supervised classification of ADEOS AVNIR data yields an 87% overall accuracy and a KHAT of 0.8350. Slight improvement in accuracy was measured when the ADEOS AVNIR was merged with JERS-1 SAR data with an overall accuracy and KHAT of 90% and 0.8730. Both the original

and the fused datasets agree on the type of landcover which is difficult to discriminate but are in dissension as to the easiest landcover to discriminate.

Furthermore, statistical tests show that the improvement in classification was not significant enough to cause any change in the use of the classification data. Thus, given the choice, one should choose the faster, more practical, simple and efficient approach, considering that the type of imagery to be classified would not be a factor.

RES 199510 PELAGIO, Gemma C. (MS Remote Sensing)
Land Use Change Detection in the Metropolitan Manila Southern Fringe Using Remote Sensing Imagery. 1995

Monitoring of agricultural lands conversion is vital for an agricultural country like the Philippines. For the past years, agricultural lands are rapidly being converted to urban uses such as industrial, commercial and residential which have a grave effect on the food security of the country. Due to the pressures of urban expansion, land conversion is even more pronounced in the rural areas situated in the fringes of Metropolitan Manila such as the Metropolitan Southern Fringe.

The study area is located south of Metro Manila, bounded by latitudes N 14° 15' to N 14° 25' and longitudes E 121° 00' to 121°12'. Being very near to the burgeoning city of Metro Manila, the study area has experienced rapid and unmitigated conversion of fertile agricultural lands into urban uses. Areas which had been devoted to agricultural lands before are now converted residential, commercial and industrial uses. Although, land use plans were prepared and land use policies were formulated and implemented, these were not sufficient to monitor the rapidity of land use change from agricultural to urban use in the rural-urban fringes. Up-to-date information is needed in updating existing land use information system which can provide the most recent land use information. In this respect, use of remote sensing and GIS technologies are very valuable and advantageous in providing current land use information.

This study focuses in the detection of rural to urban land use changes for three time periods (1988, 1992 and 1993) using satellite imageries from SPOT and LANDSAT TM. Imageries for two consecutive

dates were merged which produced two merged images for the three satellite imageries. These merged images were further subjected to three change detection techniques namely: 1) Simple Composite Overlay, 2) PCA (Principal Components Analysis) and NDVA (Normalized Vegetation Index) which produced a change map for the multidate merged images. Accuracy assessments of the classified images produced by each technique showed that in detecting rural to urban land use change, the classified image produced by simple composite overlay had comparable accuracy results as the classified image produced by the PCA. Because the mixed pixel responses in an urban area, PCA aided in the decorrelation of the spectral values thereby highlighting the subtle spectral differences between the different urban features.

Integration of the change map in a simple GIS application provided a comprehensive system to identify, locate and quantify the converted agricultural lands per administrative municipal unit through time from 1988 to 1993. This information can further be included in the monitoring and evaluation mechanisms of various land use policies and programs in providing a spatial framework for reconciliation of conflicting and competing land uses.

RES 199711 RAMOS, Euca R. (MS Remote Sensing)
Multiple Sensor Approach to Spatial Growth Analysis at the Urban Fringe. 1997

The process of urban growth unfavorably involves, among other implications, drastic conversion of traditional land uses towards urban inclination. Notwithstanding their notable benefits, these developmental changes often occur without due planning, coordination and consideration of the consequences; thus, precipitating socio-economic problems and aggravating environmental degradation. It may be entirely improbable to curb this process. However, the magnitude of its effects make it imperative to carefully and thoroughly study its dynamics and take into account its impacts particularly at the urban fringe where this unwarranted encroachment is strongly manifested.

The success of such endeavor, as in any other study, is contingent on the utilization of relevant information that incorporates the subject of interest. This requires timely, reliable and cost-effective data that is truly reflective of the development pressures arising from such a phenomenon. In this light, Satellite Remote Sensing has proven to be a vital source of

spatial information that can be used to study changes associated with urban growth.

This study explored the utilization of a multitemporal satellite imagery from different sensor systems for an automated change detection analysis in the urban fringe. Based in the assumption that this approach can provide vital insight on the dynamics of land use change, the digital data was used to formulate a strategy to identify changes associated with urbanization in the said area. The technique employed was intended to enable the analyst and other potential users to maximize capabilities of Satellite Remote Sensing technology as well as offer an alternative research tool for land use studies and other pursuits.

The images used consisted of Landsat Thematic Multispectral (1993), SPOT Panchromatic (1991), and SPOT Multispectral (1998), which were initially rectified to a common grid coordinate system for the mutual overlay functions of subsequent change comparison. The spatial resolution of the Landsat TM was enhanced by digitally merging it with the Panchromatic, though a copy of the original TM was preserved as control data. To account for spectral variations that could affect the change detection process, the resulting TM was calibrated to the radiometry of the SPOT Multispectral. After preprocessing, the change analysis was initiated.

The change detection technique applied was the conventional Maximum Likelihood algorithm that distinguished the corresponding change and non-change cover classes among the images. The Accuracy Assessment showed that the different strategy employed yielded significant results.

Overall, this undertaking demonstrated that data from various sensor systems could be employed in automated change detection. Problems arising from image incompatibilities can be addressed through standardization of the data. As a viable systematic change detection strategy, it offers as an alternative research tool for urban growth and land use studies as well as other potential fields of inquiry.

RES 200312 RAMOS, Ian Dominic S. (MS Remote Sensing)
Applied GIS and Remote Sensing in Planning Routes for Irrigation Canal Systems (The Case of Matuno-

Santo Domingo Communal Irrigation Project in Nueva Vizcaya, Philippines). 2003

This study presents a method in planning for irrigation canal routes using modern earth data acquisition and spatial analysis technologies – Remote Sensing (RS) and Geographic Information Systems (GIS). The method is specially proposed as an alternative to the long, tedious, costly, and sometimes dangerous conventional way of locating canal routes by ground survey. The process involved in conventional ground surveying for canal route planning were analyzed for stages where information about geographic location play crucial roles but are hampered by instrument and environmental constraints. These stages are best served by utilizing RS and GIS technologies because of their capabilities in acquiring data from great distances and from integrating geo-referenced phenomena. The Matuno-Santo Domingo Communal Irrigation Project in Bambang, Nueva Vizcaya provided an interesting case to apply the methodology. Available maps and other survey data from the National Irrigation Administration-Nueva Vizcaya Provincial Irrigation Office (NIA-NVPIO) project were converted to digital format and organized into a GIS environment in Arcview®, while a Landsat-TM image of the study area was classified to come up with a comprehensive landuse/landcover map. A digital elevation model (DEM) was created from the digitized contour lines and spot height. The identified and geo-referenced water sources were overlaid on the DEM, and together with information about water discharge rates, soil types, cadastral boundaries, and the cropping calendar of the Matuno-Santo Domingo area, this facilitated the delineation of possible canal routes and approximation of route costs.

Using RS/GIS techniques, the canal route identification process took 60 days to complete. Its output map yielded 53.56 km irrigation network over 1,090.75 hectares of irrigable areas across the 10, 084.21 hectares of the study area. The conventional method of canal route identification by ground survey was approximated by the NIA-NVPIO project team to take 273 days for only 1,227.27 hectares of surveyed land. This would cover 31.91 km of canal network for 520 hectares of irrigable areas. An overlay of the maps for the two methods showed upstream agricultural areas that the conventional method had missed. It also showed the need to construct additional farm ditches to distribute water to the poorly irrigated portions of the irrigable lands.

The subjects of comparison between the conventional and RS/GIS-assisted canal route planning were identified, and revolved around the extent of mapped area, completeness of identified agricultural areas, distribution of canal systems on these areas, perpendicularity of irrigation canals, speed, cost, exposure to work hazards and delay factors.

RES 199713 ROA, Melo Jane D. (MS Remote Sensing)
A Geographic Information System (GIS) Assisted Modeling Technique in the Estimation of Soil Moisture in the Angat Watershed. 1997

Soil moisture content in the Angat watershed was measured through point sampling using an ordinary hand auger. The information obtained from the nine sampling points using the point measurement did not fully depict the distribution of the available soil-water content over the entire area.

The distribution of soil moisture over large areas was proposed to be estimated by modeling the different parameters. Mathematical modeling was achieved through correlation and regression analyses of several dependent and independent variables.

There were ten independent variables included in the study. These were composed of soil properties, climatic, topographic, and land surface parameters. The actual soil moisture content obtained through point measurement was identified as the dependent variable. The measurement of these variables were obtained from two seasons (wet and dry) and two soil depths (0-15cm. and 15-30cm.).

Pearson's correlation analysis using the SPSS version 6.0 was used to determine the relationships of each of the variables. Stepwise linear regression procedures using a confidence level of 90% or $\alpha = 0.10$ was applied to form a regression equation.

As an important aspect in regression analysis, hypothesis testing was employed to determine the relationship between variables. This was achieved through the combination of the graphical analyses and statistical tests.

The results of the analyses lead to the derivation of the models. Possible model candidates were evaluated using statistical measures to determine the goodness-of-fit of the regression model equation.

Considering two different seasons and soil depths, four models were proposed in estimating the soil moisture content in the Angat

watershed. Out of the four proposed models, three appeared to be acceptable for estimating the amount of water content in Angat while one model was determined to have violated the assumptions of a good model and was therefore excluded.

The results of the mathematical models were used to determine the spatial distribution of soil moisture content in the Angat watershed for each land cover type from different seasons and soil depths. Translation into graphical forms was done using the GIS technique. Maps were created using a combination of the PC-based ARC/INFO, workstation-based ARC/INFO and ArcView softwares.

Soil moisture distribution maps at two seasons and two soil depths were obtained using GIS which can be used for decision making processes and as input for hydrological studies.

RES 199914 SALAMANTE, Erlinda E. (MS Remote Sensing)
Assessment of Climate Change Impact on Land Capability of the Makiling Forest Reserve. 1999

A simulated soil erosion-based land capability classification was used in this study to assess the impact of climate change on the Makiling Forest Reserve, Philippines.

The impact assessment was based primarily on the effect of rainfall change on the land capability of the study area. The simulated values of rainfall up to the year 2075, extracted from the GCMs of the global climate system, were used to represent climate change. These values were used as inputs to the USLE model to elucidate the information needed.

The parameters, namely, rainfall, soil erodibility, slope length, slope steepness, land cover and management, and erosion control practices were incorporated/ included in the USLE model. The data were processed and analyzed with the use of SAGE, a geographic information system software.

Climate change was projected by comparing the result of the present land capability classification with that of the simulation result. Results showed that changes in rainfall (3 mm average monthly change) could greatly affect the land capability of MFR. More than 90% of the entire forest reserve was predicted to have an ‘unacceptable’ soil erosion by year 2075. the municipalities of Calamba, Laguna and Sto. Tomas, Batangas are the areas identified to suffer the most if the predicted climate change would prevail. From these results, amendments and creation of appropriate policies can be done for the sustainability of the MFR.

RES 199615 SALVADOR, Jerry Hervacio G. (MS Remote Sensing)
Analysis of Change and related Post-Eruption Geologic Processes in Southwest Zambales, Luzon Island, Philippines. 1996

The landcover change in southwest Zambales due to the eruption of Mt. Pinatubo has been abrupt. Post-eruption geologic processes such as deposition, erosion, transport and re-deposition acting on the voluminous ash deposits on the slopes caused new geomorphic features

to be formed such as the pyroclastic fan, major lahar debris basin and the lahar-dammed lake. These geomorphic features also constitute the new landcover types in the area.

The land cove change in southwest Zambales for 1988 to 1993 is well-documented through the use of multi-temporal high-spatial resolution satellite data combined with ground truth, field maps and photographs. The time, spatial and spectral components of the imagery were stressed in the analysis.

The most important result in this study is the determination of the identity, location tend and the amount of the change component in the images. The change component represented actual changes on the ground which were verified by ground truthing. The major changes include replacement of vegetation and bare ground near the volcano and the lahar-affected river by pyroclastc flow and lahar deposits. Vegetation far from the volcano and the river showed renewed vigor while that on the southwest slope is regrowing. The scarcely vegetated slope and the agricultural land were covered by ashfall but is recovering. The reddish underlying soil and rocks are being exposed again. Some agricultural land are being tilled while others are being planted. The lahar-dammed lake formed is growing. The tailings pond remained essentially unchanged. The new drainage forming on the slope tends to follow the trace of the old drainage before the eruption. The crater lake shrunk due to renewed dome-building activity.

Of the change detection technique used, visual interpretation and the three-date color composite allowed rapid assessment of the major change or no change areas as well as the direction or trend of change. The post-classification comparison technique combined with the percentage change table allowed the areas covered and the amount of change to be quantified.

Based on the data presented and assuming that no drastic phenomena will occur, a long term scenario is visualized. Mainly for long term environmental monitoring purposes, it is recommended that monitoring of the southwest Zambales using satellite systems be continued and combined with ground verifications. Further, input the generated information as well as other relevant data and information gathered into a geographic information system or GIS.

RES 199516 VICENTE, Randolf S. (MS Remote Sensing)
Applications of Remote Sensing and Data Integration Techniques for Watershed Rehabilitation Planning. 1995

The study was able to show operational method of using satellite remote sensing and data integration techniques in providing vital information for watershed rehabilitation planning. It involved three major phases, namely: (1) Remote Sensing, (2) Data Integration, and (3) Output Generation.

The ESIPP Release 1.02 and Autocad Release 12 were used in the satellite image preprocessing stages while the IDRISI Version 4.1 was utilized during image classification. ERDAS Revision 7.4 enabled the conversion of the classified image into a format readable and workable within work-station based ARC/INFO. The latter software was instrumental in the preparation of the final watershed land cover and various analytical maps.

Bands 1 to 4 of the LANDSAT Thematic Mapper imagery was used to extract the preliminary land cover types of the Labey Watershed which falls within the Central Cordillera Forest and Ambuklao-Binga Watershed Reservations covered by Presidential Proclamation Nos. 217 and 548, respectively. Land use and forest resource condition maps were overlayed to be able to delineate the desired land cover categories within the watershed which are not possibly derived from the imagery such as the built-up areas.

The integration of related ancillary data with the watershed land cover information was undertaken through direct conversion of the image file in order to generate the different resource status maps including important statistics. The definition of areas for rehabilitation was included in the analysis.

Slope map was extracted through digital means using the

workstation ARC/INFO. Soil map was evaluated along with the slope data in order to draw high priority areas for rehabilitation with reference to existing government policies and biophysical considerations. Related strategies were established in order to smoothly carry-out watershed rehabilitation planning given the financial constraints of the government.

Findings show that satellite imageries can be transformed into a more useful and meaningful information through simple, rapid and effective integration with relevant ancillary data. With the aids of analytical maps, resource planers and decision-makers will be able to formulate and establish the different alternatives in pursuing rehabilitation works intended for biophysically and ecologically degraded watersheds.

The study was able to provide useful resource information for watershed rehabilitation projects through the application of remote sensing and data integration techniques. Indeed, satellite data has adequately supplied major data inputs in planning and managing the country's natural resources and are considered to be an effective tool for generating important resource data for national development programs.

Newer and more advanced methods of satellite remote sensing, computer-assisted image data processing and digital cartography are revolutionizing the process and production of resource maps and information. What is now needed is the integration of knowledge in the fields of remote sensing, resource inventories, photogrammetry and cartography in order to speed up production and to improve the quality of resource thematic and analytical maps.

New technologies should be introduced and made accessible to maximize benefits that would relieve ourselves form the old labor-intensive and low-productivity methodologies. If adopted, they will improve and facilitate sound natural resource management and development.

RES 199717 VINLUAN, Randy John N. (MS Remote Sensing)
A Fractal Approach to the Classification of Land Cover in Radar Imagery. 1997

This thesis aims to determine whether fractal analysis is a useful means for characterizing land cover in radar imagery. Specifically, it aims to determine which of two methods- the triangular prism surface area method and the box-counting method-perform better at distinguishing

between various land cover types. It also seeks to establish the spatial scales at which the radar images exhibit fractal properties. Finally it seeks to determine how speckle filtering affects the computed fractal dimension and whether this will enhance classification.

Thirty synthetic aperture radar images of seven land cover types (bay areas, forested areas, mountainous terrain, rice fields, river areas, urban areas, and wetlands) are represented as a three-dimensional backscatter surface with the pixel and the line coordinates of the image serving as the x- and y-coordinates of the backscatter surface and the backscatter value as the z-coordinate.

Using two methods for the computation of the fractal dimension - the triangular prism surface area method and the box-counting method – four fractal parameters are computed: the Fract3D dimension, capacity dimension, information dimension, and correlation dimension. Discriminant analysis is applied to these parameters, as well as two statistical measures – the image and standard deviation – to determine the separation between the different land cover types.

Results show that the box-counting method performs better in the classification of the different land cover types than the triangular prism surface area method, whether the images are speckle-filtered or not, but only by 1.5 to 7 percent points. However, no single box-counting dimension is consistently superior to the Fract3D dimension. Including all fractal and statistical measures in the analysis yields an overall classification accuracy of at least 65%.

Speckle-filtering results in an image set with totally different fractal and statistical properties from the original, with the exception of the capacity dimension for bay areas and the information dimension for urban areas. This, however, does not improve our ability to classify the various land cover types under study.

Examination of the log-log plots of the cell resolution against the computed surface area shows that fractal properties for radar imagery exist at spatial scales ranging from 60 meters to 480 meters.