

# Current Situation of Monitoring Forests and Ecosystem Services in Myanmar

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## Abstract

Myanmar is often cited as the last frontier of global biodiversity in Asia. Out of about 10,000 plant species recorded to date, 1,071 are endemic. It also has a rich wildlife resource which includes over 1,000 species of birds, more than 300 species of mammals and 400 species of reptiles and amphibians. The present forest cover of Myanmar and the current and sustained yields of teak and other valuable hardwoods indicate that the Myanmar Selection System, together with its least destructive logging method, work well and that also sustain biodiversity to a remarkable extent even in the production forests. The new Forest Law (1992), in conformity to the Myanmar Forest Policy (1995), focuses on the balanced approach toward conservation and development issues implicit in the concept of sustainable forestry and highlights environmental and biodiversity conservation. The biodiversity and ecosystem services, being natural heritage of the country, it deserves to be safeguarded for the benefits of both present and future generations. Today's primary focus of monitoring forest resources has been shifted beyond forests and trees. As development activities have intensified and increasing population has spread onto marginal lands, problems of deforestation, soil degradation, wetlands drainage and diminished biological diversity have paramount environmental concerns. Therefore, there is an urgent need for adequate information bases from which appropriate resource monitoring and management strategies and interventions can be derived.

## 1. Introduction

The Union of Myanmar, a tropical country in continental South East Asia, with a total land area of 676,553 km<sup>2</sup> is most interesting from an ecological point of view as there is a wide range of latitudes; flat lands at sea level to snow-capped peak of over 6,000 meters and deep ravines, wide range of temperature and rainfall. Annual precipitation varies 5,000 mm in the coastal and deltaic regions to 750 mm and less in the rain-shadow of the central dry zone where mountains running along the Rakhine Coast blocks the heavy monsoon rains. Extremely high summer temperatures over 40°C are not uncommon in the central dry zone. Due to varying degrees of climatic and topographic conditions and a wide range of latitudes, the forest flora varies from sub-alpine to typical rain forest species.

In the Indo-Malaysian bio-geographical realm, Myanmar is one of the countries where half of the total land area is covered with dense forests. It is well known as the natural home of Teak (*Tectona grandis*), one of the world's premier tropical timbers. The forests of the country are the habitats of diverse species of wildlife. They are of

paramount importance for national economic development and one of the major export commodities.

The effective management of forest resources requires comprehensive reliable and timely collection of data. Conventional ground surveys of forest resources have been practiced since the start of the scientific forest management in Myanmar. The first method of remote sensing used for forestry purposes was aerial photography. First introduction of satellite remote sensing system to Myanmar was in 1980.

In Myanmar, increased population pressure and consequent rising demands for the forest land and its products, forest resources of the country have been decreasing both in extent and quality. Therefore, Myanmar Forest Department has put in utmost efforts to check further depletion and degradation of the Nation's natural wealth while appraising its status now and again. Knowledge of the type, locality, extent, quality and accessibility of land cover classes and of the current land use situation is needed to establish a realistic database for national planning of economic development, sustainable management of natural resources and environmental protection in a developing country like Myanmar. Remote sensing techniques and forest inventory have been used to assess and monitor forest resources of Myanmar. Besides, several laws concerning with forestry sector have been promulgated during early 1990s to straighten the direction towards the goal of the scientific forest management in Myanmar.

## 2. Forest Cover

Already four appraisals have been made of the forest cover status of Myanmar. The first one, carried out in 1962, used aerial photographs taken in the 1950s, while the later ones are conducted in the 1980s based on the satellite images of the 1970s and 1980s. The fourth appraisal was based on the analysis of the 1989 Landsat TM imageries.

The Forest Resource Assessment (FRA 2005) conducted by the Food and Agriculture Organization of the United Nations (FAO) in cooperation with the Myanmar Forest Department has indicated that Myanmar is still endowed with a forest covered area of 52% of the country's land total area of 676,553 km<sup>2</sup>, one of the highest in the Asia-Pacific Region. The status of forest cover is shown in the table.

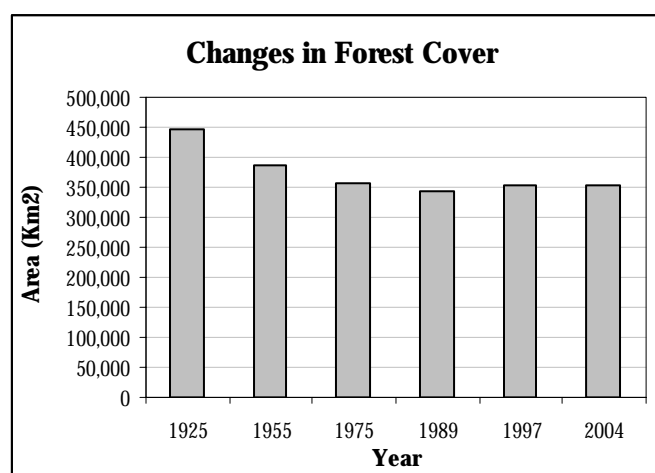
Category	Area (ha)	% of total land
Closed Forest	25,516,600	37.71
Degraded Forest	9,970,500	14.74
Other Wooded Land	10,545,000	15.59
Other Land Use	21,623,200	31.96
Total	67,655,300	100

Source: 1998 appraisal (FRA 2005), Forest Department, Myanmar

### Forest Cover at Different Periods

Year of appraisal	Forest cover (km <sup>2</sup> )	% of total area
1925	445,187	65.8
1955 (1st Appraisal)	387,003	57.2
1975 (2nd Appraisal)	356,656	52.7
1989 (3rd Appraisal)	343,701	50.8
1997 (4th Appraisal)	353,747	52.3
2004 (FRA 2005)	354,780	52.4

Source: FRA 2005, Forest Department, Myanmar



Source: FRA 2005, Forest Department, Myanmar

The assessment of the change in forest cover conducted in 1990 revealed that the actual forest cover had decreased at an annual rate of 220,000 ha or 0.64% of the actual forested area during the period of 14 years from 1975 to 1989. The change was mainly due to shifting cultivation, illicit cutting and encroachment for the agricultural purposes.

### 3. Forest Resources

#### 3.1. Natural Forests

Myanmar is rich in forest resources. Out of about 11,800 plant species recorded to date, 1,071 are endemic. There are 1,347 species of big trees, 741 species of small trees, 1,696 species of shrubs, 96 species of bamboos, 36 species of rattan and 841 species of orchids so far recorded. Out of the 2,088 tree species, 85 have been recognized and accepted as producing multiple-used timber of premium quality. Studies on the properties and utilization of the lesser-used timber species are being carried out, and their utility extensively promoted to increase commercial production and reduce the pressure on the premium quality timber like teak. Forest area of the country has been estimated by forest types and function as shown in table below.

### Forest Area by Types of Forests

No.	Types of Forests	Area (km <sup>2</sup> )	% of Total Forested Area
1.	Tidal, beach & dune, and swamp forests	13,750	4
2.	Evergreen forest	55,004	16
3.	Mixed deciduous forest	134,068	38
4.	Deciduous <i>Dipterocarp</i> forest	17,187	5
5.	Dry forest	34,377	10
6.	Hill evergreen forest	89,378	25
7.	Fallow land	9,983	2
Total		353,747	100

Source: Myanmar Forestry Statistics, 2004

### Area by Forest Function

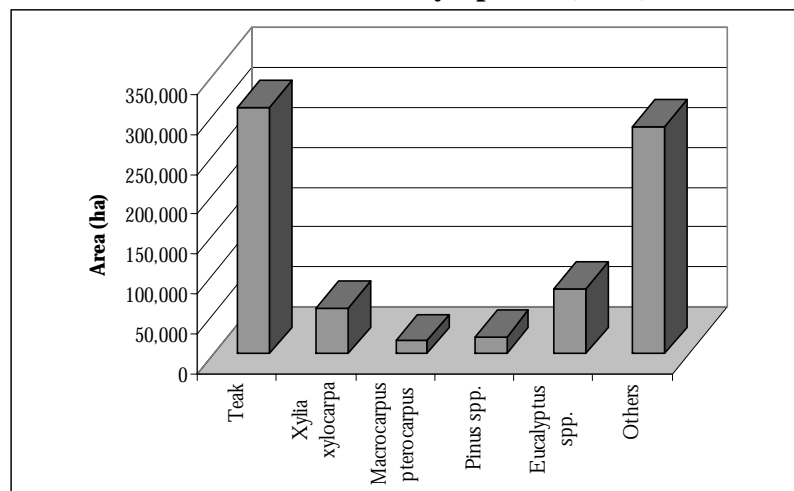
Category	Area (km <sup>2</sup> )	% of total land area
Permanent Forest Estate (PFE)	104,013	15.37
Protected Areas System (PAS)	49,887	7.37
Total Area of Reserved Forest	153,900	22.74
Other Forests	189,660	28.03

Source: Myanmar Forestry Statistics, 2004

### 3.2. Plantation Resources

Attempt on establishment of teak plantation use of *Taungya* (Agroforestry) method was first made in 1856. The success with *Taungya* method led to a wide spread planting of teak, *Acacia catechu*, and *Xylia xylocarpa* and by 1930, a total of over 19,000 ha had been planted. Large scale plantation forestry program began in 1980 and more than 30,000 ha of forest plantations have been established annually since 1984. The special teak plantation program, structured with a series of 8 consecutive phases was initiated and has implemented since 1997. During each phase, a total of 40,500 ha would be planted. The program would therefore have established a total of 324,000 ha of teak plantations at the 40-year rotation. A total of 768,930 ha of forest plantation had been planted up to 2004.

### Area of Forest Plantations by Species (2004)



Source: Myanmar Forestry Statistics, 2004

### 3.3 Bamboo Resources

Bamboo grows abundantly throughout the country either mixed with tree species or in pure stands. Pure stands of Kayin-wa (*Mellocanna bambusoides*) stretch over an area of about 8,000 km<sup>2</sup> on the Rakhine mountain range with an estimated growing stock of 21 million metric tons. The bamboos in the Bago Division are of mixed forest type consisting of a number of different species of which Kyathaung-wa (*Bambusa polymorpha*), Tin-wa (*Cephalostachym pergracile*) and Myin-wa (*Dendrocalamus strictus*) are commercially important. Of the 96 known species of bamboo only about 13 species are considered commercially important so far.

### 4. Biodiversity Status

Myanmar is often cited as the last frontier of global biodiversity in Asia. Out of about 11,800 plant species recorded to date, 1,071 are endemic. It also has a rich wildlife resource which includes over 1,000 species of birds, more than 300 species of mammals and 400 species of reptiles and amphibians. Out of those recorded species such as the Asian elephant, tiger, Thamin deer, Ayeyarwady dolphin, guar and four species of marine turtles are included in the list of global endangered species.

Four bird species namely; hooded treepie, white-browed nuthatch, white throated babbler and Myanmar yuhina are endemic. Myanmar also has the most diverse snake fauna in the old world tropics. The country has 68 swallow-tail butterflies so far recorded and ranks the world's fifth richest in this respect. However, 45 species of mammals, 39 species of birds and 36 species of reptiles in Myanmar have been listed as endangered.

#### **4.1. Wildlife Conservation**

At present, 32 wildlife sanctuaries and 8 park systems have been established. The present forest cover of Myanmar and the current and sustained yields of teak and other hardwoods indicate that the Myanmar Selection System, together with its least destructive logging method, works well and that it also sustains biodiversity to a remarkable extent even in the production areas.

The new Forest Law (1992), superseding the old Forest Act of 1902, in conformity to the Myanmar Forest Policy (1995), focuses on the balanced approach toward conservation and development issues implicit in the concept of sustainable forestry and highlights environmental and biodiversity conservation. Consequently the old "Wildlife Protection Act (1936)" was replaced with the new "Protection of Wildlife, Wild plants and Natural Areas Law" in 1994 in order to carry out biodiversity and environmental conservation more effectively. Moreover, the Government of Myanmar is also a signatory to the Biodiversity Convention and the Climate Change Convention.

#### **4.2 Ecosystem Services**

The biodiversity and ecosystem services, being natural heritage of the country, it deserves to be safeguarded for the benefits of both present and future generations. Today's primary focus of monitoring forest resources has been shifted beyond forests and trees. The well-being of people and their environment as well for now and the future has become the highest priority in forestry. This wider perspective on forests has resulted in a shift from managing forests on sustained yield basis to sustainable management of forest ecosystem.

As a result of wild resources conservation, the Myanmar natural forests provide ample opportunities for ecotourism. In order to promote forest based ecotourism operational plans have been laid down and on-site activities are being undertaken for upgrading and improving the Wildlife sanctuaries. The apparent biodiversity of the marine and corral reefs, and the forest and wildlife resources within protected areas are of significant conservation values on regional and global scale.

### **5. Institutional Arrangement**

Four institutions namely; Planning and Statistics Department (PSD), Forest Department (FD), Myanmar Timber Enterprise (MTE), and Dry Zone Greening Department (DZGD) under the Ministry of Forestry are performing their specific duties and responsibilities mainly related to forestry. The Forest Department is the main arm of the Government for forestry sector policy and program implementation.

Forestry research is an old activity in Myanmar and subsequently strengthened with the establishment of the Forest Research Institute (FRI) located in Yezin and under the administrative control of the Director-General of Forest Department. FRI was commissioned in 1978 and it has 77 researchers and 202 supporting staff. Up to now, about 200 research papers have been documented, some 26 research studies in diverse fields of forestry are on-going. While FRI has the Forest Department and the Dry Zone Greening Department as its main clients for forest research, it is an isolated institution in regard to other user agencies as a result of which lab-to-land transfer of research findings remain constrained. Collaborative research to ensure the use of

resources and research findings, and coordination and cooperation between research institutions/ universities and overseas research institutes are still being sought for.

The importance of forestry education and training is also being fully recognized by the Government. Degree in Forestry was conferred years ago in Yangon and presently the University of Forestry has been relocated and upgraded at Yezin. UOF offers the degree of Bachelor Science in Forestry, Post-graduate diplomas and the Master's degrees in the field of forestry. The University has started offering Ph.D courses since 2003. There is also a technical training school at Pyin Oo Lwin. An in-service and public training centre supported by JICA has been established at Hmawbi.

## **6. Myanmar Forest Policy**

In view of the importance of the Myanmar forestry sector in enhancing national socio-economic development and ensuring ecological balance and environmental stability the Myanmar Forest Policy (1995) has been formulated in a holistic and balanced manner within the overall context of the environment and sustainable development taking full cognizance of the forestry principles adopted at UNCED. It formalized the commitment and intent of the Government to ensure sustainable development of forest resources while conserving wildlife, plants, and ecosystem.

The forest policy focuses on the **Protection** of soils, water, vegetation and wildlife, **Sustainability** of forest resources, satisfying the **Basis needs** of the people, **Efficiency** in harnessing the full economic potential of the forests, **People's participation** in forest management and biodiversity conservation and raising the **Awareness** of the people and the decision makers in forestry.

### **6.1. Forest Legislation**

- **Forest Law 1992** - superseding the Burma Forest Act 1902, the new Forest Law was enacted in 1992, with adequate provisions for increased private sector involvement, community participation, biodiversity conservation, and increased forest resources security
  
- **Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994** - The Wildlife Protection Act 1936 was replaced by the new Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law in 1994. Under the new Law, the modern concept of biodiversity conservation was introduced and the need for extended formulation of the protected areas system was also highlighted.

## 6.2. Regulation

- **Departmental Instructions for Forest Officers in Burma 1955** include the procedure for:
  - Forest reservation
  - Working plans preparation and updating
  - Maintenance and review of girdling
  - Registers include future yield trees
  - Climber cutting and improvement felling
  - Selection marking of non-teak hardwoods, report keeping, and
  - Measurement and royalty marking of logs extracted under long-term agreement
  
- **Working Plan Manual, Burma 1938** - To realize the key role of working plans (Forest Management Plans), the working plans manual was first published in 1938 and revised in 1957. The manual has highlighted the importance of full utilization of existing data, working circle information, repeated improvement fellings for better condition of the forests and calculation of yield for both teak and other hardwoods. The revised working plan manual was reprinted in 1961. The Forest Department had completed updating and reformulating the working plans and forest management plans for the district (FMU) level covering the entire country by the end of 1998. For this process to be consistent, the Forest Department, in consultation with concerned organizations and their professionals, developed the format and guidelines for District Forest Management Plans in 1997, in line with SFM principles and other international forestry protocols.
  
- **Standing Orders for Subordinates, Forest Department 1959** - The standing orders provide prescriptions for subordinate staff to carry out forest works including amongst others, the following:
  - Girdling of teak and selection marking of non-teak hardwoods
  - Climber cutting, improvement felling and boundary maintenance and repair
  - Measuring and hammering of timber and other forest products
  - Inspection of harvesting coupes under long term leases
  - Stump inspection after felling, and
  - Maintenance and upkeep of compartment registers
  
- **Forest Rules 1995** – The Forest Rules, prescribed in 1902 were replaced by the new Forest Rules in 1995, issued by the Ministry of Forestry. In order to facilitate implementation of the 1992 Forest Law, the new rules also place emphasis on increased formation and protection of reserved forests and protected public forests, sharing of forest management responsibility with the local communities, establishment of fast growing plantations on degraded forest lands to conserve soil, water and biodiversity and harvesting of timber and other forest products in an environmentally sound manner.



- **Community Forestry Instructions 1995** – were issued by the Forest Department in 1995 and marked a significant development in the aspects of partnership, participation and decentralization in managing the forests in Myanmar. The instructions grant the local communities trees and forest land tenurial rights for an initial 30-year period, which is extendable. The Forest Department provides technical assistance and plays the leadership role in the exercise of community forestry.
- **Existing Timber Extraction Manual, Logging Rules and Procedures** – regarding teak log, FD and MTE jointly apply the Logging Rules and Standards for Jungle Rejection of Teak Logs which was issued by the Chief Conservator of Forests, Burma in 1936. Also in existence were the Grading Rules for Teak based on the MTE practices and FAO's general guidelines. The Extraction Department of MTE has issued and adopted the following:
  - State Timber Board Extraction Manual 1948
  - Standing Orders for Extraction Staff 1970
  - Departmental Instructions (Series 1-20) for Extraction Department 1986

## **7. Assessment of Future Supply and Demand for Forest Products and Services**

The Forest Department has been undertaking the following major activities, inter alia:

1. Reservation of forest lands up to 30% of the country's total land area from the present status of about 15%.
2. Establishment of forest lands under Protected Areas System up to 10% of the country's total land area from the present status of about 7%.
3. Preparation and updating of 10-year Management Plan at the district level for efficient conservation and development of forestry sector.
4. Initiation to introduce "polluter pays" system for the protection of forest resource.
5. Initiation and practice of establishing "cess money" from commercial trade of timber and other forest products.
6. Introduction of management responsibilities sharing through adoption of community participatory forestry to rehabilitate degraded forest lands.
7. Continued practice of re-forestation program at an annual rate of about 20,000 ha.
8. Periodical review on Forest Policy, Legislation, and Institutional Arrangement to keep pace with social preference and international priorities.
9. Continued effort to formulate and adopt multi-sectoral national land use policy respected by all parties concerned.
10. Continued effort for the promotion of private sector in forestry development program without compromising the carrying capacity of forest ecosystems for the well-being of future generations.
11. Continued effort for the promotion of wood-based industries for increased production of value-added finished products.
12. Encouragement and liberalization of trade and tariff policies to ensure reasonable stability of the declared policies.

13. Continued endeavour to strengthen Research and Development activities.
14. Continued effort to promote human resource development and institutional capacity building.

With the above major activities, the exercise of sustainable forest management in Myanmar would become a more effective tool, providing forest goods and services to meet the increasing demand.

## **8. Assessment and Monitoring of Forest Resources**

Over the last 20 years, new technology has increasingly been used in assessing forest resources, including microcomputers, long-distance surveying via low- or high-resolution satellite, and GIS and global positioning systems (GPS). Considering the essential role of forest assessment and surveillance in good forest management, forest authorities should allocate resources to assessment and surveillance. Like other developing countries, Myanmar is in lack of adequate forest inventory resources. In addition, the accurate and updated information is very critical for resource planner and decision markers. Thus, it is vital to build the necessary capacity.

### **8.1. Ground Forest Inventory**

Forest inventory in Myanmar dates back to 1856 when Dr. Brandis applied linear valuation survey to collect forest statistics in Bago Yoma. Recording of teak trees 4 ft gbh (39 cm dbh) left standing during girdling was started in 1922. This information on the growing stock of teak has been used ever since as the basis for estimating the future yields in the forest working plans. A trial on the application of modern sampling techniques in forest inventories was conducted in 1963 covering a forest reserve of about 40,000 ha. The trial had indicated that forest resource statistics could be secured with precision good enough for planning purposes. Consequently, starting from 1964, regional forest inventories were carried out using either stratified two-stage or stratified replicated sampling techniques.

Large-scale forest inventories at the national level were initiated in 1981 under the National Forest Survey and Inventory Project, carried out with the assistance of UNDP/FAO. For the first time, a Continuous Forest Inventory (CFI) system emerged with the project. At the second phase, the National Forest Management and Inventory Project became operational for another five years. Since the termination of the project in 1993, Forest Department has been conducting forest inventory, covering about two million ha each year, with its own resources. A five-year plan of forest inventory has been drawn up to cover various states and divisions, starting from 1996 to 2001, so as to include all secured areas of the country.

## **8.2. Resource Monitoring Using Geoinformatics**

As the use of remote sensing techniques in forestry is an auxiliary tool with which to obtain data for a special purpose, remote sensing technology in the form of aerial photography was introduced in Myanmar as early as 1920s for the forestry purposes and revision of topographic maps. Aerial photography continued to play an important role in topographic maps compilation and forest cover assessment and large part of the country had been covered by aerial photography in two different periods 1950s and 1970s. No complete coverage for the whole country was acquired at any period.

Satellite remote sensing was first introduced in Myanmar in 1980 by FAO/UNEP Project. Landsat MSS images taken between 1972 and 1979 of 1:1,000,000 scale B/W prints for all bands and one colour composite transparency each of all 44 scenes were provided for forest cover assessment for the whole country. Manual interpretation method was conducted and forest cover area of the whole country was assessed. The reference year for this appraisal was 1975. Altogether 6 land use classes were identified, viz., closed forest, degraded forest, closed forest affected by shifting cultivation, degraded forest affected by shifting cultivation, non forest area and water. Though deforestation has occurred increasingly it has never been systematically determined until Landsat imageries were obtained.

The UNDP funded project BUR/79/011 " National Forest Survey and Inventory Project" (NFI) began in 1981 and during the project about 50% of the country was covered by aerial photography and two sets of Landsat MSS imageries for the period of 1974-1980 at 1:1,000,000 and 1:250,000 were acquired. The follow-up project (MYA/85/003) "National Forest Management and Inventory Project" (NFMI) provided more funds to continue aerial photography and at the termination of the project over 95% of the country was covered by aerial photography, leaving only the border areas and some hilly areas. Over 400 forest type maps were produced using the newly acquired aerial photographs. A set of Landsat TM imagery for the period of 1989-90 at 1:500,000 scale was acquired and a countrywide land-use map was produced by visual interpretation (the fourth appraisal).

During the project period of NFMI (MYA/85/003), a PC based Arc/Info GIS was installed in July 1993. Several geographic databases and land-use maps were produced on a pilot scale using the GIS system.

A digital image processing system PCI EASI/PACE was installed in early 1996 with the financial assistance of the Watershed Management for the Three Critical Areas Project (MYA/93/005). The system incorporated with the GIS system to produce land-use maps for the sustainable development of critical areas. The Forest Department has been a pioneer in the application of GIS system in Myanmar and has now become one of the major GIS users having a moderately well-equipped GIS unit.

Although the Global Positioning System (GPS) technology existed for quite a number of years now, the introduction of its application to Myanmar was quite recent. The FAO/UNDP project (MYA/93/005) provided the first GPS units and now several GPS units are available at Forest Department. They are mainly used for locating of ground control points in the process of ground truth in digital image processing.

### **8.3. Present Image Classification Methodology in Myanmar**

Image classification methodology commonly used at the Forest Department is still manual classification. In this methodology, remote sensing is used to improve the visual interpretability by enhancing the spectral differences between the objects under the study and to choose the best band combination that can provide the maximum information for the display of a colour composite. After the best image for the specific purpose is created, a paper print of the image is produced and visual interpretation is carried out on the paper print-out with the aid of aerial photographs, forest type maps and local knowledge. Ground truthing is done eventually after the initial interpretation. GPS is used for this purpose. After final classification is done, all of the classified results (land-use/ land-cover) are converted into vector format for further GIS analysis. At the same time basic map data such as roads, streams, forest reserve boundaries, etc., are also digitized from topographic maps and created map layers. They are overlaid onto the classified image layer to get the final map. Consequently, spatial statistics for each class are calculated by using both Arc/Info Tables and Excel spreadsheet.

### **8.4. International Cooperation**

International organizations, mainly FAO/UNDP, have supported the capacity building of remote sensing and GIS infrastructure of the Forest Department by providing technical assistance as well as logistics.

A Three-year Information System Development Project (ISDP) with The Forest Agency of the Japanese Ministry of Agriculture, Forestry and Fisheries was started in 1995 for the management of tropical forests in Myanmar. During the project period, the Japan Forest Technical Association (JAFTA) acquired the most recent Thematic Mapper (TM) satellite data and conducted digital image processing in Japan. With the assistance of the Myanmar Forest Department inspection was carried twice a year in Myanmar. Topographic maps (1:253,440) indicating the boundary information of the townships and forest reserves were acquired from the Forest Department to use for geometric compensation and preparation of overlay information. Finally, forest type maps and related data in the form of forest registers were produced and presented to the Myanmar Forest Department. After the termination of the three-year project, it was extended another one year and five more Landsat scenes were digitally classified. During the project period, altogether 23 Landsat scenes have been finished in digital processing. On the whole the project has provided computer hard ware and soft ware, satellite digital data, false colour composites, forest type maps, and forest registers. ESCAP/NASDA contributed hard ware and soft ware, remote sensing and GIS facilities and satellite digital data for a research project in 1999.

## **9. Conclusion**

Myanmar, a country endowed with a wealth of forest resource, possesses a fauna and flora of unusual diversity. The biodiversity, being natural heritage of the country it deserves to be safeguarded for the benefit of both present and future generations.

Myanmar is no exception in facing with problems such as shifting cultivation, acute demand for firewood by ever-increasing population, over-exploitation for internal revenue and foreign exchange earnings, illicit logging with weakness in monitoring, clearing of forest for more attractive forms of land-use, etc. Myanmar, being a developing country has to utilize the forest resource for its economic and social development. Keeping in line with the new forest policy, the Forest Department practices the balance approach towards conservation and development issues implicit in the concept of sustainable forestry.

For management and planning of natural resources, precise, frequent and timely information is a requirement. Remote sensing brings an answer to resource managers who have been concerned with the spatial distribution, identification and inventory of resources over a large geographical area. GIS system fulfils the increasing need to combine remotely sensed data with other ancillary and varied data such as DTM, soil types, weather and political boundaries, etc. In this way remotely sensed data can be used as inputs to a GIS for analysis and decision making.

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