

Leaflet No. 5 /1991



**Government of the Union of Myanmar  
Ministry of Forestry  
Forest Department  
Forest Research Institute  
Yezin**



**A Study of Changes in Forest Cover and Landuse Types in  
Part of Teak Kinda Watershed Area Using Sequential  
Aerial Photographs**

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1991

# ကင်းတားရေဝေရေလဲဒေသအချို့ ရှိ သစ်တောနှင့်မြေအသုံးချမှု ပြောင်းလဲပုံများကို ကောင်းကင်ဓါတ်ပုံ အသုံးပြုခြင်းဖြင့် လေ့လာသုံးသပ်ခြင်း။

ဦးစောအယ်ဒါး (B.Sc. (For.) (Rgn.),Dip( Forest Survey) I.T.C.,)  
အကြီးတန်းသုတေသနမှူး  
သစ်တောသုတေသနဌာန

## စာတမ်းအကျဉ်းချုပ်

လွန်ခဲ့သောနှစ်များအတွင်း ကင်းတားရေဝေရေလဲဒေသရှိ လူဦးရေတိုးတက်မှုနှင့် လယ်ယာမြေ တိုးချဲ့မှုကြောင့် သစ်တောမြေအချို့သည် လယ်ယာမြေနှင့် ရွှေ့ပြောင်းတောင်မြေများအဖြစ် အသွင်ပြောင်း လျက်ရှိပါသည်။ သစ်နှင့် ထင်းလိုအပ်မှုကြောင့်လည်း အချို့သစ်တောများမှာ တန်ဖိုးနည်း တောပျက်များ အဖြစ်ရောက်ရှိခဲ့ပါသည်။ စာတမ်းတွင် ကောင်းကင်ဓါတ်ပုံ ဖတ်ရှုလေ့လာခြင်းနည်းဖြင့် ကင်းတား ရေဝေရေလဲဒေသ ဧရိယာ ၆၉၀၀၀ ခန့် အတွင်း ပြောင်းလဲမှုများကို ခန့်မှန်းတိုင်တာ တွက်ချက်ခြင်းဖြစ်ပါ သည်။ မူလ သစ်တောမြေ ၂၂၆၆၀ ခန့်မှ (၂၅) နှစ်အတွင်း ၅၄၅၀ဧက (၂၄%)မှာ ခြုံ၊ တောင်ယာနှင့် အခြားမြေများ အဖြစ်သို့ ပြောင်းလဲပြီး ရွှေ့ပြောင်းတောင်ယာမြေ ၄၁၀၀ ခန့် မှ ၂၆၅၀ ဧက(၆၅%) ထပ်တိုးပွားလာကြောင်း တွေ့ရှိရပါသည်။ ကာလအတွင်း လယ်ယာမြေ၂၁၃၅၀ ဧကခန့်မှ ၁၄၅၀ ဧက (၇%) ခန့် သာ ပိုမိုတိုးပွား လာကြောင်းတွေ့ရှိရပါသည်။

## **A Study of Changes in Forest Cover and Landuse Types in Part of Teak Kinda Watershed Area Using Sequential Aerial Photographs**

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### **Abstract**

In the past decades many watersheds in Myanmar have been seriously disturbed by unsuitable land use practices and particularly by resource depleting shifting cultivation, uncontrolled extraction of fuelwood, forest fires and many other. This is an estimate of the rate and magnitude of Land cover & Land use changes that had taken place during a period of 25 years in the demonstration area within the Kinda Dam Watershed by a simple photographic interpretation method. Results show that from a total of 22660 acres of forested land 5450 acres (24%) had been reduced to scrub, shifting cultivation area and other land categories in 25 years. Shifting cultivation increasing conspicuously by 2650 acres (65%) or 2.6 % annually from 4100 acres during this period while permanently cultivated land expanded by 1450 acres (7%) from an original 21350 acres .

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## 1. Introduction

A knowledge of land use and land cover is important for many planning and management activities concerned with the surface of the earth. The use of panchromatic, medium - scale aerial photographs to map land use has been an accepted practice since the 1940s. More recently, small scale aerial photographs and satellite images have been utilized for land use / land cover mapping of large areas.

Air photography and visual reconnaissance can play important roles in supplying the basic information necessary to solve a wide range of land use problems in agriculture, forestry, vegetation and soil surveys, erosion and land reclamation and many others.

In addition, aerial photographs are an important source of information concerning changes in land use over time. These changes indicate trends that can be extrapolated to predict future land use with and without various planning and zoning restraint (Paine, 1981).

In Myanmar the use of aerial photographs was introduced when an area of some 1400 square miles of Ayeyarwady delta consisting almost entirely of dense tropical Mangrove forest was surveyed in 1924 by means of vertical photography in combination with an adequate triangulation survey (Sisam, 1947). Since then, subsequent aerial photographic mission were conducted, covering almost the entire region of the country (Aggrawal, 1980). The recent an most updated one being the aerial photographs at a scale of 1: 25, 000 taken by the National Forest Survey and Inventory Project, covering some priority forested areas during the 1981 and 1985. (Allen,1985). In 1987-88, special aerial photographic flights were conducted for the Pilot Watershed Management for Kinda Dam Project resulting aerial photographs of 1:10, 000 scale covering the entire watershed area.

This is an estimate of the rate and magnitude of land cover and land use changes that had taken place during a period of 25 years in the proposed demonstration area within the Kinda Dam Watershed by a simple study with photographic interpretation. The significance and location of changes examined as a priority of need for information to assist in the planning of an effective implementation of watershed actions in the area.

## 2. Literature Review

Different approached have been tried for monitoring changes in forest cover over time. Some applied complicated methods of using satellite imagery assisted by computer classification while others are still relying on conventional aerial photographs which is much simple and less costly.

In monitoring shifting cultivation and grazing patterns in Kenya's semi-arid region, medium scale, multi-date, panchromatic black-and-white aerial photographs and Landsat MSS data were analyzed using various manual and computer-assisted methods. The primary sources of information were panchromatic black- and-white aerial photographs of three dates 1963 (1:60,000), 1975 (1:50,000) and 1980 (1:20,000); and Landsat MSS (positive transparencies of bands 4,5,6 and 7 Of 17 May 1973 and 18 June 1979 and a non-geometrically corrected CCT of 17 May 1973). To asses land use and land cover changes in the study area for the 1963 to 1980 period, all interpreted data were overlaid by a grid. Line maps were registered onto base grid, two at a time. A clear sheet of acetate was placed on top of the composite, and area of changes between the two dates were marked and measured on the acetate.

Results show that black-and-white aerial photographs at medium scale (1:50,000 to 1:30,000) are best for detailed analysis of shifting cultivation and grazing patterns in the semi-arid regions of Kenya. Digital methods could be used on only a few test sites because they involve great expense in both infrastructure and personal training and were not found

to provided any major improvement on the manual methods (Woyumba and Philipson, 1985).

For monitoring deforestation in the Amazon region of Brazil, interpretation was carried out on film overplays to black- and- white prints of MSS imagery of bands 5 and 7 for the period 1973 to 1975 and 1976 to 1978. The areas from the first period were drawn in outline and those from the second period were shaded, to obtain a graphic representation of the progress or incidence of deforestation over time. Areas of deforestation were then measured with a dot grid. (Baltax, 1980)

The Royal Forest Department of Thailand, in its earliest application of landsat imagery to determine the existing area of forest for the whole country, carried out interpretations on black-and-white prints of MSS images of bands 5 and 7 at 1: 50,000 recorded in 1973. This information was supplemented by information from 1:1 million diazo colour composites of some scenes, some analysis on a colour additive viewer, interpretation of aerial photography of selected areas and field checks carried out on a number of 25 x 25 m samples plots. (Morain and Klankamsorn,1978). This was compared with results of an inventory based on aerial photo-interpretation and ground survey completed in 1961, which showed an apparent decrease in the area of forest from about 55% of the county's total area to about 38%.

In northern Thailand an area of some 64,000 km<sup>2</sup> was mapped from parts of seven landsat scenes all recorded in January 1973 as a first step towards controlling shifting cultivation within several major watershed areas. The same methods were applied and in this case two classes of forests were mapped as well as the distribution of the areas of shifting cultivation and the boundaries of the main watershed, all at 1:75,000. This enabled the identification of the critical watersheds where protection and management were most urgently required and provided baseline data for monitoring subsequent changes.

In 1980 FAO conducted an appraisal of the forest cover of Myanmar using 1: 1,000,000 scale landsat imagery of the years 1972-79. Two methods were used to assess the rate of deforestation. The first one was based on the comparison of aerial photographs taken in the 1950's at a scale of 1: 20,000 and 1: 50,000 and the landsat imagery of 1:1,000,000 scale taken between 1973 and 1979. The other method was based on the number of people, determined by projecting the 1973 census data, practicing shifting cultivation. The first method estimated the deforestation rate at 1.45% in 20 years or 0.07 % (23,320 ha) annually. According to the second method, the annual deforestation was estimated at 95,000 ha (FAO 1981).

A new appraisal using 1979-81 landsat imagery at 1:1,000,000 scale was made based on the same forest classification. Comparing the landsat imagery of the years 1979-81 as updated to 1980's to the 1973-79 adjusted to 1975 landsat imagery, the results indicated that forest depletion was much greater than that envisaged by the 1981 report. As conservative estimate it may be taken at 600,00 ha annually (Allen,1984).

In 1985 two Myanmar Foresters conducted an estimate of changes in cover types in 17,000 acres of the East Paga Yoma region. Interpretation was made on black and white aerial photographs covering two different time periods. The earlier photography was taken in 1953-54 at a scale of 1:24,000 and the more recent one in 1983-84 at a scale of 1:25,000. Four broad forest types, cultivated areas, forest plantations and, the remainder, grouped as others, were defined in this study. Results showed that cultivated areas increased by 550 acres annually (Win and Dah, 1985).

### 3. Materials and Method

The area under study is part of the Kinda Watershed Management Project area which falls within the township of Ywangan in the Shan State. It covers some 69,300 acres with the Aung Ban Ywangan motor road running approximately along the middle throughout the length of the area. The boundaries are as follows.

- North - The northern boundary follows the Aung Ban-Ywangan road to the point where it meets the Panma chaung from which it proceeds along the latter. It then follows the Chaungyi chaung, then the Natkan chaung, and goes right up to the ridge which divides the Panlaung and Zawgyi drainages.
- East - The eastern boundary goes southwards along the above water divide, which also is the township boundary, and parts from it just east of the village of Yewin towards the Pwebya village. No natural boundary exists between the two villages.
- South - The southern boundary passes just north of the Pwebya village to the village of Taungtogwe from which it follows the kattabo chaung to the point where it meets the Panlaung chaung.
- West - The western boundary follows the Panlaung chaung, the Yinzit chaung and finally the Inhla chaung up to the point where it meets the Aung Ban-Ywangan road.

Interpretation was made with a Topcon mirror stereoscope on panchromatic black-and-white aerial photographs covering the area within the reference points LL 990580 to LM 170580 of the Indian Survey map 93 C and LL 990310 to LL 170310 of the map 93 D. Photographs covering two different time periods were used. The earlier photographs, obtained from the Survey Department, were taken in 1958 at a scale of 1: 50, 000 and the more recent ones made available by the National Forest Survey and Inventory Project, were taken in 1983 at a scale of 1 : 25, 000.

The areas under study consists of a number of vegetation types and the investigation defined the cover types and land categories as follows:

- (1) Dry upper Mixed Deciduous Forest. It is the same as described in the Burma Forest Types and a negligible amount of Indaing Forest is included in this study.
- (2) Hill Forest - This includes the Hill Evergreen and Dry Hill Forests.
- (3) Scrub Forest - This comprises scrubs of both DUMD and Hill Forest Origins.
- (4) Grassland - This includes grasslands with almost pure grass on the high ridges as well as those mixed, in various degrees, with shrubs and herbs on the lower slopes, usually with few scattered trees.
- (5) Shifting cultivation - This depicts areas 60 percent or more affected by shifting cultivations, old and new.
- (6) Village Woods - These are mostly woods at springs and along streams protected by village authorities, and also those around monasteries. The wooded areas include bamboos, shade trees and trees for firewood.
- (7) Cultivated Land - This is made up of permanent agricultural lands of both dry and wet nature. It also includes village areas as most villages have home gardens for tea, coffee and fruits within their peripheries.

- (8) Barren Hills - This is exclusively barren hills or "pwe- taung " having loose mineral sids, and usually with rock outcrops.
- (9) Other s- All objects and features other than the above. i.e. water - bodies, roads, etc.

The minimum area of delineation was approximately 6 acres and the type boundaries as determined on the photographs were transferred to the base map of 1:63,360 scale by means of a Bausch and Lomb stereo Zoom transfer scope. Area estimates for the individual types were made with the aid of a dot grid transparency laid over the two type maps prepared for each time-period and checks were made with a compensating polar planimeter. To collect ground truth data samples a field check was made in early February, 1988. Since the entire area could not be covered during the short visit local informations had also been taken into consideration.

Sequential changes in vegetation were evaluated using the reciprocal vegetation sequence method in which different type units were counted and recorded in a " cross table" (see table I). The spatial distribution of the cover types and land categories are shown in simplified maps (fig.1 and 2) for the two time period while the histograms (fig .3 and 4) indicated their quantitative distribution.

#### 4. Results and Discussion

Table I shows the reciprocal changes in different categories of all cover types as estimated from the 1958 and 1983 aerial photographs of the study area.

As seen in the table, the forested area of 22664 acres (8386 acres of DUMD and 14278 acres of hill forest) in 1958 had been reduced by 5454 acres, or 24 percent, to 17210 acres (6189 acres of DUMD and 11021 acres of hill forest) in 1983; an annual loss of 220 acres.

From 8386 acres of DUMD in 1958, 1180 acres (14%) had been reduced to scrubs, 848 acres (10%) to shifting cultivation while 169 acres (2%) had been transformed to cultivated land in 1983. In the same period, out of 14278 acres of Hill forest, 1973 acres (14%) had been reduced to scrub, 840 acres (6%) to grassland and 560 acres (4%) to shifting cultivation while only 84 acres (0.6%) had been replaced by agricultural land.

In the 25 year period, scrubland increased by 18 % from 8108 acres to 9537 acres, while grassland had been reduced by 3% from 7533 acres to 7277 acres. Shifting cultivation expanded conspicuously by 65% from 4108 acres to 6764 acres whereas cultivated land increased at a modest rate of 7% from 21357 acres to 22810 acres. Village wood areas decreased by only 3% while 230 acres of scrubland gave way to Barren Hills; an increase of 10 % for the latter.

Concerning with the degradation of the forests, a close study of the maps prepared from the interpretation shows that both the DUMD, to the west of the Aung Ban - Ywangan motor road, and the Hill forests, to the east of it, were effected. The problem was most acute at the fringes usually in areas close to the villages and decreased gradually towards the interior of the forest lands. One large of Hill Forest which remained virtually intact at the Northeast corner of the map suggests poor accessibility, probably due to mountainous terrain.

Shifting cultivation had been detected to increase in areas of DUMD forests, Hill Forests, Scrublands and even grasslands. Mosaics of shifting cultivation and grassland had been observed and were found to be less common on high ridges with pure grass than on lower slopes where grass mixed with shrubs and herbs.

The slight increase in permanently cultivated land suggested that encroachment was not as heavy as might previously be anticipated. Other discoveries to note are that erosion gullies of conspicuous size were absent in the cultivated areas and that village woods were



well preserved. A small catchment area of about 200 acres to the east of Yagyi village (South -east corner of the map) which had been occupied by scrub in 1958 was replaced by a fairly stocked forest in 1983. A small dam down- stream suggested that some conservation work had been present in the mini-watershed.

## **5. Conclusion**

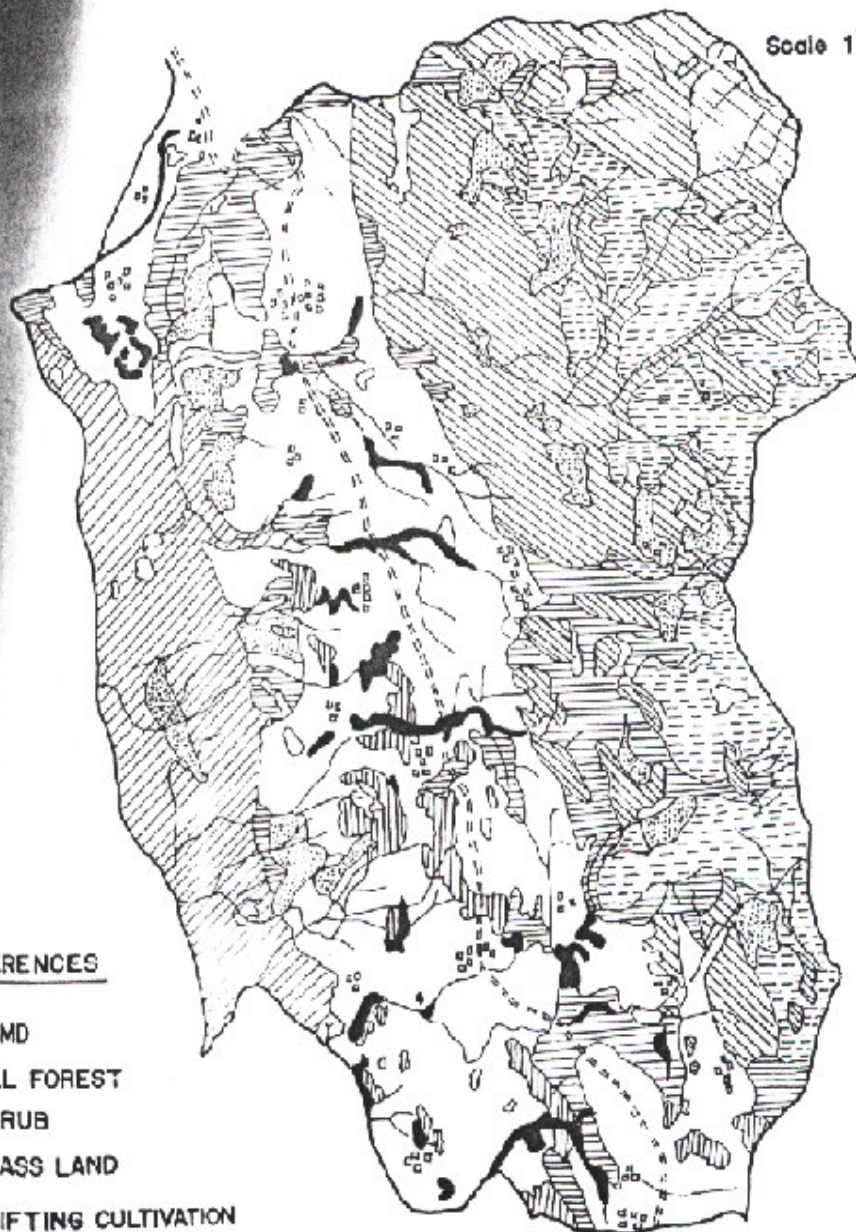
1. Although permanent cultivation encroachments existed as a component of deforestation, shifting cultivation practices and heavy firewood cuttings are the principal factors of deforestation.
2. Based on the distribution on different covertypes in the study area (Fig. 3 and 4) it is quite evident that about 200 acres of forest had been reduced to scrub or fallow land annually within the past (25) years.
3. Restoration of forests in mini-watersheds with the same methods carried out in the small catchment area east of Yagyi village could be treated as a remedy against further depletion of forest lands and should be encouraged in areas undergoing degradation.
4. The remarkably well preserved village woods, especially at springs and along streams clearly indicates that the local people will appreciate the value of these woods. It is of paramount importance to co-operate with the village authorities to further protect or even increase these woods for better soil and water conservation.

The present study again demonstrates a relatively cheap and less time- consuming method of obtaining an over-all assessment in monitoring changes over time. It is also a proffered method suitable for carrying out preliminary surveys which precede more detailed ground investigations.

COVER TYPE MAP OF STUDY AREA 1958.



Scale 1" = 2 miles



REFERENCES

- ▨ DUND
- ▨ HILL FOREST
- ▨ SCRUB
- ▨ GRASS LAND
- ▨ SHIFTING CULTIVATION
- VILLAGE WOOD
- CULTIVATED LAND
- ▨ BARREN HILL



Fig - 3

Histogram showing the distribution of all cover types as interpreted from Aerial photographs taken in 1958.

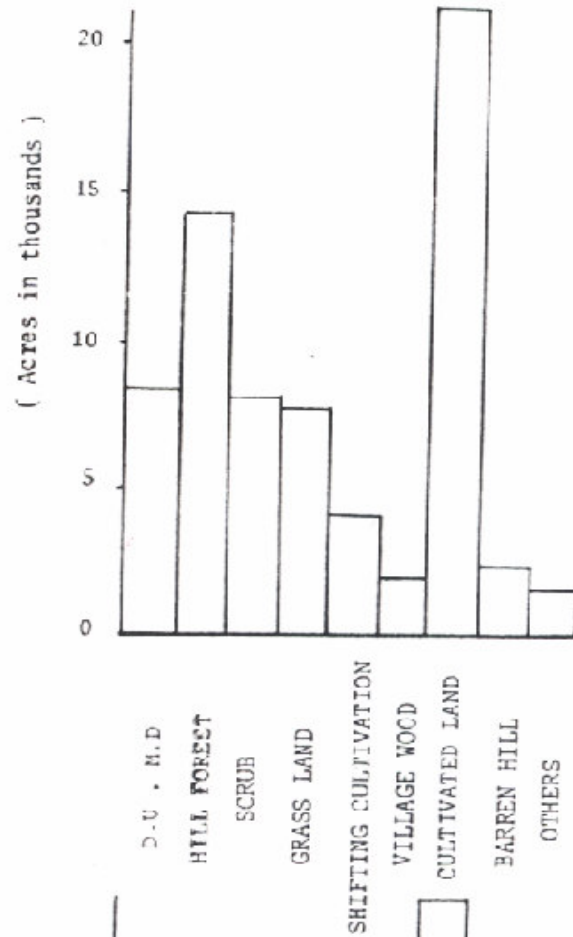
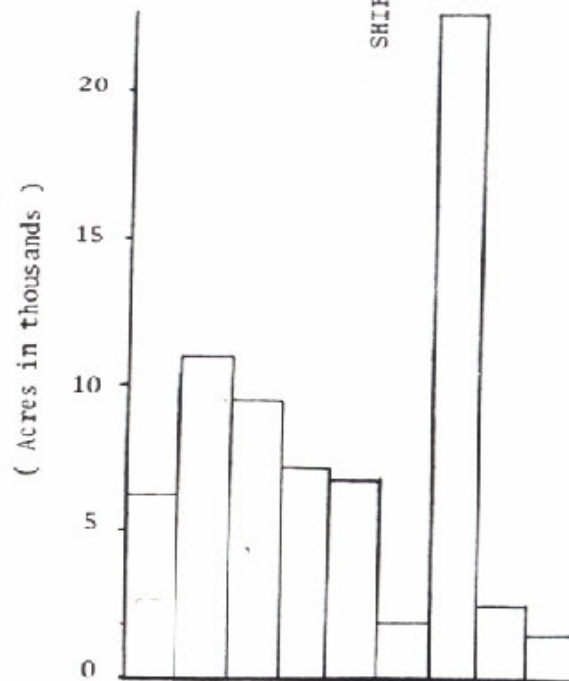


Fig - 4

Histogram showing the distribution of all cover types as interpreted from Aerial photographs taken in 1983.



**Table 1. Cross table showing reciprocal changes of cover types in (25) years between 1958 and 1983.**

1958 \ 1983	DD	HF	SC	GL	SC	VW	CL	BH	Ot	Total
DD	6189									6189
HF	-	10821	200							11021
SC	1180	1973	6352		-	32	-	-	-	9537
GL	-	840	-	6437	-	-	-	-	-	7277
SC	848	560	746	1060	3550	-	-	-	-	6764
VW	-	-	-	-	-	1792	-	-	-	1792
CL	169	84	580	36	558	26	21357	-	-	22810
BH	-	-	230	-	-	-	-	2189	-	2419
Ot	-	-	-	-	-	-	-	-	1491	1491
Total	8386	14278	8108	7533	4108	1850	21357	2189	1491	69300

DD - Dry Upper Mixed Deciduous

HF - Hill Forest

SL - Scrub

GL - Grassland

SC - Shifting Cultivation

VW - Village Wood

CL - Cultivated Land

BH - Barren Hills

Ot - Others

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