
CHAPTER TWO

MATERIAL AND METHODS

2.1 Study area

The Koyna river rises near Elphinstone point ($17^{\circ}58'$ N and $73^{\circ}43'$ E) at Mahabaleshwar in the Sahyadri hill range and flows for about 120 km before meeting river Krishna at Karad. Initially the river flows in north-south direction almost parallel to the Arabian sea coast for a distance of 65 km from Mahabaleshwar to Helwak, through a deep 'V' shaped valley, skirting king Shivaji's Fort at Pratapgad on the way. After the dam site at Helwak (Tal. Patan, Dist. Satara) the river turns sharply eastwards and travels for 56 km till Karad.

Unlike the other rivers originating in the Western Ghats which flow in an eastern or south western direction, and attract high rainfall only at their source in the west, the Koyna, flowing through the high mountains and parallel to the Arabian sea for more than half its course, catches in its deep boat like basin a rainfall of well over 5080 mm a year for a length of 65 km. It is this unique feature which economically catches huge quantity of water in the 891.78 sq.km. "Shivaji Sagar" reservoir.

The Koyna Valley is in the Satara district at the Western limit of the Deccan table land. It lies between $16^{\circ}50'$ and $18^{\circ}10'$ North and $73^{\circ}45'$ and $73^{\circ}15'$ east. The valley is distributed in Jawali, Mahabaleshwar and Patan tahasil. The valley from the source waters to the dam place is almost longitudinal, possibly occupying a geological fracture, and is deep and narrow. During this run it flows with the main line

of the Sahyadri on the right and on the left the Bamnoli-Gheradategad branch of the Sahyadri which runs parallel to the main line at an equal height. In Jawali the river receives Solshi tributary from the left and Kandati tributary from right about 5 kms north and south of Bamnoli village respectively.

The study area is totally a hilly area. The lava beds at the plateau tops are capped by laterite with characteristic red and brown colour and is composed of hydrated oxides of alumina, iron and bauxite, the largest deposits are found at Ghatmatha.

At the time of the construction of the Koyna Dam there were about 150 settlements in the watershed. The total area of these settlements was 917 sq.km. Out of which an area of 495.59 sq.km was in charge of forest department, 482 sq.km. was privately owned land and 4 sq.km belonged to other Govt. departments. The forest area constituted 50.6 % and private ownership 49.05 % of the total land in the watershed. The total net catchment area was however 891.78 sq.km (fig.1).

Out of the privately owned area 95.5 sq.km is under regular cultivation and over 382 sq.km is either under shifting cultivation or is a fallow land. Most of these areas belonged to the land capability classes 3 to 8 and these areas needed to be managed on Scientific basis.

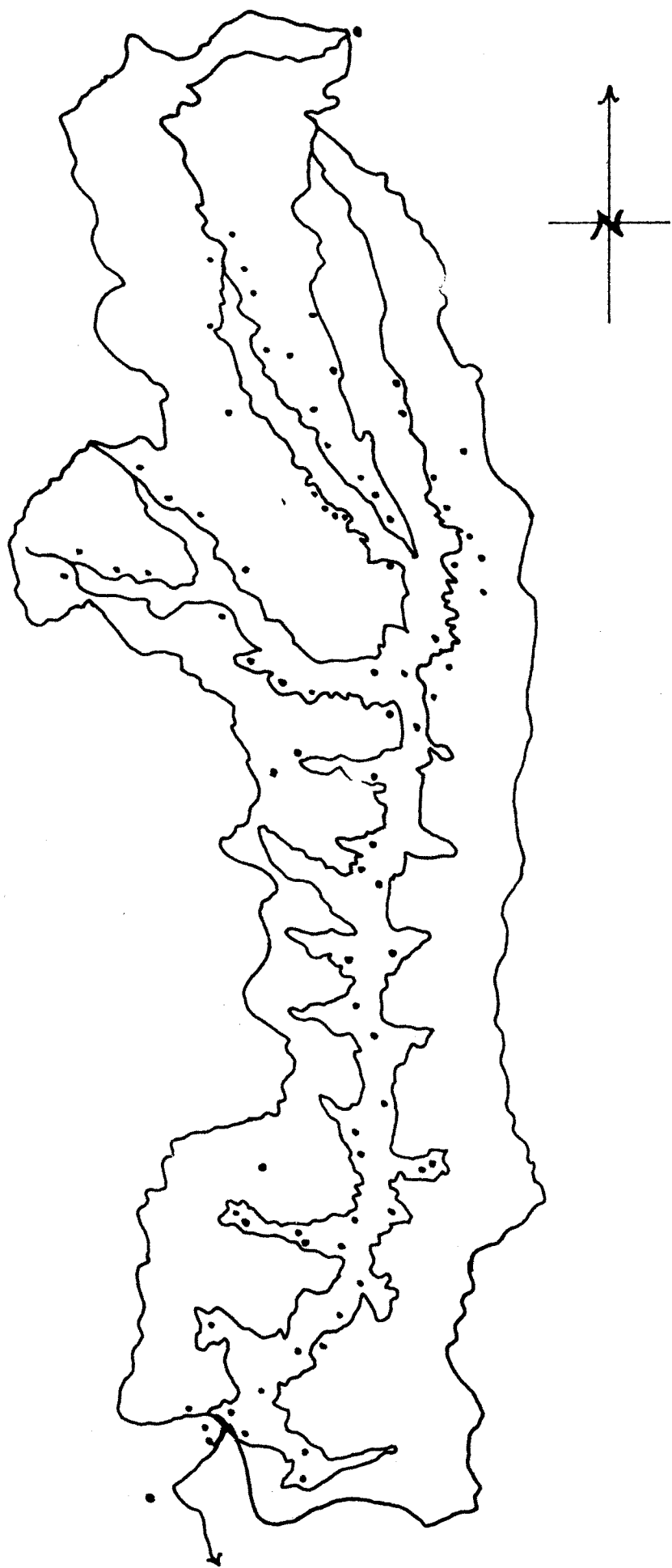


Fig 1: Koyna dam catchment with settlements.

Main Features of the
"Koyna Hydro-Electric Project"

<u>Area</u>	<u>Phase I & II</u>	<u>Phase III</u>	<u>Phase IV</u>
1. Catchment area	891.78 sq.km	25.40 sq.km	
2. Water spread	115.35 sq.km.	1.67 sq.km.	
3. Capacity			
a. Gross	2796.5 mm ³	36.22 mm ³	
b. Net	2662.0 mm ³	11.22 mm ³	
4. Project affected villages	98	6	
5. Project affected families	9069	355	
6. Maximum height of Dam above river bed	85.35 m	56.80 m	
7. Length	807.72 m	497 m	
8. Power Generation	560 MW	320 MW	750 MW
9. Expenditure (March 79)	66.15 crore	59.96 crore	273.16 crore

Koyna Wildlife Sanctuary :

Koyna Wildlife Sanctuary (Fig.2) a total area of 423.55 sqkm was declared by Govt. of Maharashtra by sub-section (1) and (2) of section 18 and section 19 of the Wildlife (Protection) Act, 1972 (53 of 1972) on 16th September 1985 "by reason of its ecological, faunal and floral significance, needed to be constituted as a

KOYNA WILDLIFE SANCTUARY

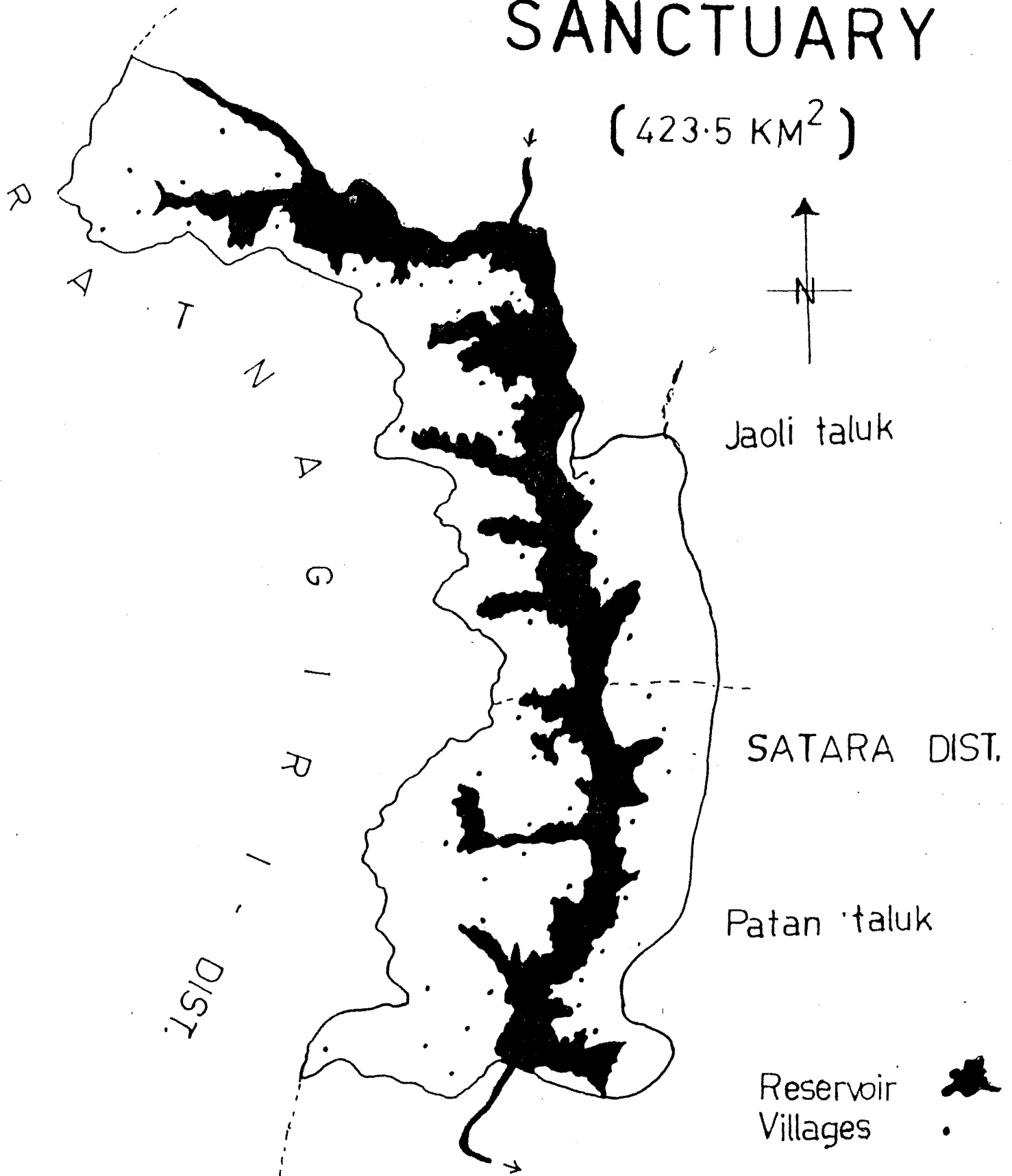


Fig 2: Koyna Wildlife Sanctuary with the Settlements studied during investigations

wildlife sanctuary for the purpose of protecting, propagating or developing wildlife therein or its environment".

The sanctuary has a total of 51 villages from Patan and Jawali tahasils. Out of these almost 50 % villages are in each tahasil. During the present investigations a total of 20 villages and their environs were studied. The villages belong to eastern catchment (6) Western Catchment (9) and out of the catchment ^Q respectively. The villages are Eastern Catchment - 1. Nahimbe Ambeghar, 2. Shirshinge, 3. Gojegaon, 4. Kathi, 5. Aral, 6. Kusawade, Western Catchment :- 1. Dicholi, 2. Zadoli, 3. Zadoli-Ambeghar, 4. Kistrul-Mura, 5. Punawali-Dhokawale, 6. Punawali-Kistrule, 7. Mirgaon, 8. Kamargaon, 9. Humbarli; Out of the Catchment :- 1. Gokul, 2. Torne, 3. Ghatmatha, 4. Shiwandeshwar, 5. Mandheghar. 5

2.2 Methodology

The study was conducted for a period of ¹⁶ 14 months from June 1986 till August 1987. After the initial review of literature and government reports, field visits were made to determine the study area. Considering the pioneering nature and magnitude of the undertaken problem the plan of work was finalised. Due to lack of earlier work of similar nature, there was no basic data available.

Initial visits were made to the study area to get an idea of the practical problems likely to be encountered

Table No. 2 : Maximum and minimum values of annual rainfall and number of rainy days in the two periods, 1955-1960 and 1980-1985, at the four stations, two east and two west catchment, alongwith the annual mean values of rainfall and rainy days at each station during both the periods.

	Rain fall in mm			D a y s		
	MAXIMUM	MINIMUM	MEAN	MAXIMUM	MINIMUM	MEAN
<u>1955-1960</u>						
Koyna	6462.21	4429	5525.73	132	103	120
Navja	7250	5367.30	6253.22	132	115	124
Valvan	8616.25	7106	7719.10	125	92	108
Kathi	5248.75	3683.25	4376.02	130	98	108
<u>1980-1985</u>						
Koyna	6076	3212.8	5307.86	118	98	109
Navja	6584.60	4819.80	5707.06	116	103	111
Valvan	6154	2053.56	3902.52	122	68	99
Kathi	4049.75	3500.5	3749.08	118	72	102

Table No.3 : Change in the Status of Villages in the Study area.

Sr. No.	Original villages in the Catchment	Villages at submerge	Rehabilitated villages
1.	Karanjawade	FS	FR
2.	Rohine	FS	FR
3.	Kusawade	PS	PR
4.	Aral	Un	Un
5.	Taloshi	FS	FR
6.	Dhokawale	PS	PR
7.	Dicholi	PS	PR
8.	Shirshinge	FS	FR
9.	Zadoli	PS	PR
10.	Punoorli	PS	PR
11.	Gojegaon	PS	PR
12.	Kisrule	PS	PR
13.	Kathi	Un	Un
14.	Navaja	PS	PR
15.	Mirgaon	PS	PR
16.	Chirambe	FS	FR
17.	Nahimbe	PS	PR
18.	Dastan	FS	FR
19.	Kamargaon	PS	PR
20.	Humbarli	Un	Un
21.	Ambeghar	PS	PR
22.	Wajegaon	FS	FR
Out of the catchment villages (included in the sanctuary)			
23.	Gokul. T. Helwak	Un	Un
24.	Shivandeshwar	Un	Un
25.	Ghatmatha	Un	Un
26.	Mendeghar	Un	Un
27.	Deoghar T. Helwak	Un	Un
28.	Torne	Un	Un

Signs

Fully Submerged = FS = 7	Fully Rehabilitated = FR = 7
Partially Submerged = PS = 12	Partially rehabilitated = PR = 12
Unchanged = Un = 9	Unchanges = Un = 9

Table 4b : Composition of Land in the study area in 1961 and 1981.

	Cultivated land in hacters		Not available for cultivation land in hacters		Culturable waste land in hacters		Forest in hacters	
	1961	1981	1961	1981	1961	1981	1961	1981
West catchment	222.8	938.8	643.4	634.8	330.2	100	3550.4	1018
East catchment	395.6	2664	3579.4	522.4	7647.6	549.6	1459.6	1025.2
Out of the catchment	85.6	179.6	352.4	183.2	576.4	10	1416	146.8

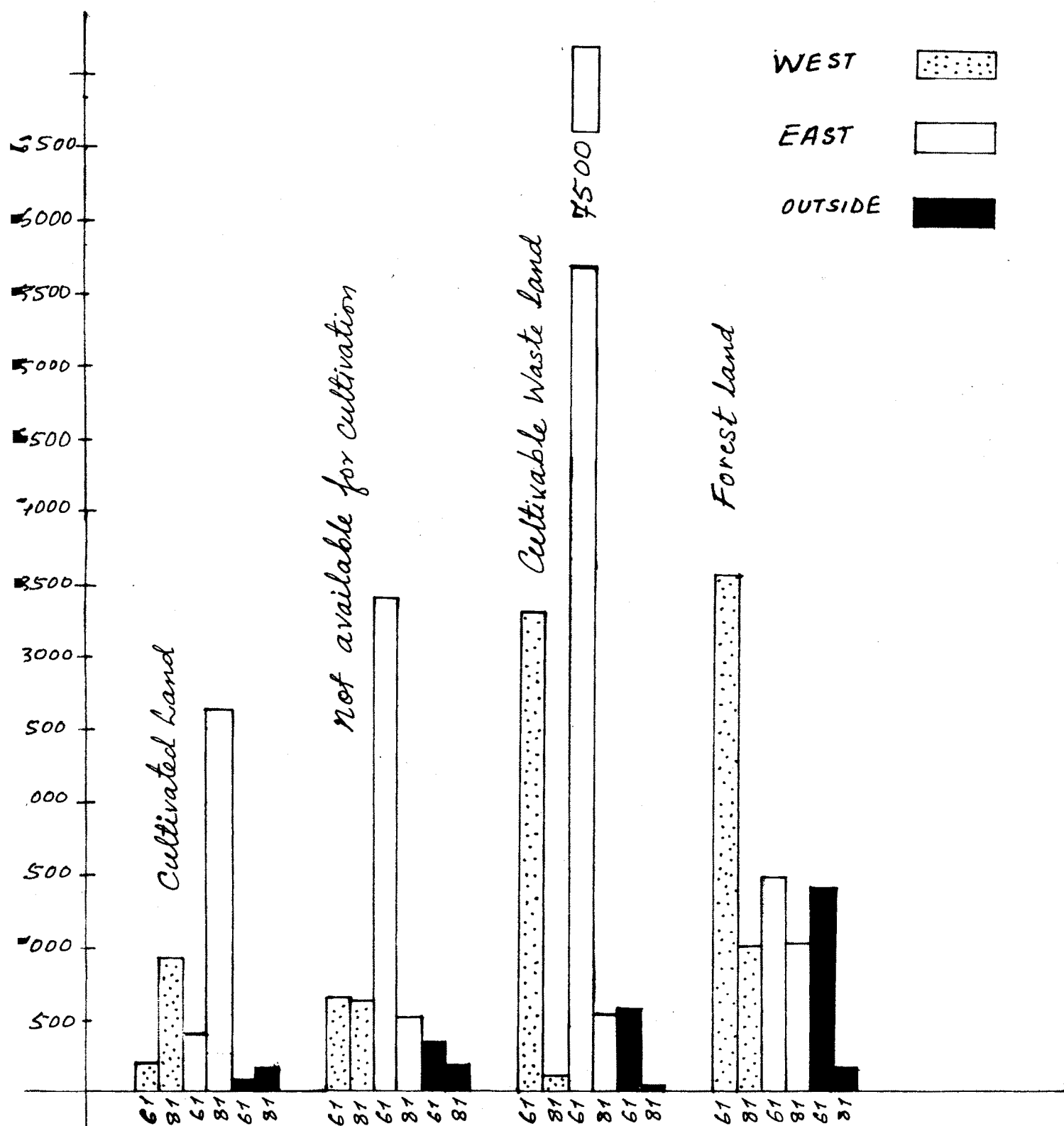


Fig 3: Composition of land in East & West Catchment and outside the catchment in 1961 & 1981.

during the investigations and suitable modifications in the working plan were made in time.

A pilot survey was conducted at the beginning of the investigations in which 35 households belonging to 5 villages from the study area were randomly surveyed to get an idea about the region and get feed back. This basic data was used in formulating the final questionnaire which was administered during the study period.

Help of local guides was taken throughout the investigations in the biological diversity studies as well as in the socio-ecological survey of the households.

The research methodology was based on animal observations and survey technique.

1. Though mammals, birds, reptiles and fishes from the study area were recorded by visual observations more emphasis was given to mammalian studies where droppings, scat analysis, pug marks, signs, skins, trophies etc were observed and identified.

2. Due to the total lack of information about the past and present status of wildlife in the study area, change in composition of crop pest, diversity, hunting and poaching activities etc. it was difficult to collect direct information. Therefore the most suitable and efficient method found to collect the required data was the stratified random sampling technique of socio-ecological survey.

Since the biological diversity is directly or indirectly

affected by various human activities, a total of 479 households were interviewed from 20 villages in the study area. During the investigations assessment method was used for the evaluation of the impact of human activities like deforestation, agriculture practices, hunting, crop pest, animal husbandary, fishing, water resources etc. The questionnaire prepared was very elaborate, having questions on 18 main topics and was 21 printed pages. The respondents were selected randomly from each village, and about 60 per cent of the households were covered.

Average time required for one interview was about 60 minutes. The interviews were taken informally after developing good rapport with the respondents. Normally the head of the household was interviewed in order to get a better picture of the past status of biological diversity of the area and the various environmental changes taking place for last few decades due to the dam construction and submergence. In the absence of the head of the household his wife was interviewed.

During the field investigations camps were made in the concerned village for 4 days to one week. During this period the flora and fauna around the village was recorded. Local field assistance was taken to visit neighbouring places of academic interest. Repeated visits were made to the areas of significance.

In most of the cases visits to the remote villages were made on foot as there was no transportation facility available in the hilly and isolated area which is cut off from rest of the world during the four months of monsoon i.e. June-September every year.

The observations on animal diversity were restricted to largely mammals due to their constant interaction with local human population as pest, prey or predator. The mammalian diversity was also considered as a crude measure of indication of the state of general biological diversity of the Koyna dam catchment.

There were difficulties in field observations on account of the difficult terrain, thick vegetation, heavy rainfall, remoteness and logistic problems. With the help of residents and local guides some solutions were always found. Also these difficulties posed some problems in the direct observations on account of the characteristic of the species studied i.e. habit, size, habitat, shy nature, arboreal life, nocturnal activities etc. Therefore whenever possible pug marks, scat, ~~scats~~, ^{were} sounds, nests, kills etc were given due consideration and used in studying the distribution and abundance of study species.

As a secondary source, hunters, poachers and local forest staff was contacted and their impressions about wildlife were also recorded for confirmation. Personal contact with these people provided excellent piece of information, which would not have been made available otherwise, after the initial difficulties.

Fisheries operations were studied at different landing stations and fishes collected even at village fish market. The fish specimens were brought to laboratory, preserved in 4 % formalin and identified.

The huge data thus generated was coded and transformed on code sheet and later fed to the computer. The computer facility used was the 4th generation computer, WIPRO S-6168 having UNEX System, at the Computer Centre, Shivaji University, Kolhapur.

The methodology of the present investigations was largely based on "Environmental Science Methods" by Haynes (1982) and Social Surveys' by Bantham and Moseley (1982). For formulating the final questionnaire, generous help was taken from Prof. K.C. Malhotra, Indian Statistical Institute, Calcutta.

The study was a part of the major research project "Studies on the Conservation Potential of the Biological Diversity of Animal Origin from the Western Ghats", sponsored by the Department of Environment, Govt. of India. The project was carried out from June 1984 to January 1988.

The research undertaken was pioneer in nature as it was the first attempt made to evaluate the impact of dam on the animal diversity in the catchment area, in any of the dam projects in the Western Ghats of Maharashtra. The scope of the work was restricted to the 50 % of the Koyna wildlife Sanctuary and almost the same composition of the Koyna dam catchment. Along with the faunal studies attempts have been made to evaluate the direct and indirect human activities on the animal diversity particularly mammals. It is expected that the data generated and analysed during this study would

prove useful not only for the future indepth studies but to find out immediate measures to conserve the rapidly vanishing wildlife diversity in the region. Perhaps the data would form the base of the management plan to be prepared for the Koyna Wildlife Sanctuary this year and Koyna Biosphere Reserve in 1990's.



Plate 1.a. Climax tropical evergreen forest
from the Western Koyna Catchment,
near Village Zadoli.



Plate 1.b. Shivaji Sagar Reservoir of Koyna
Project with Western Ghats crest
line at the background.



Plate 2.a. Settlements at the beginning of the
Koyna river with degraded surroundings.



Plate 2.b. A typical settlement in the study area
showing ample use of wood.



Plate 3.a. Original thick evergreen forest with excellent undergrowth. Note the Camouflaged Sambar Stage Cervus unicolor.



Plate 3.b. Tall trees with open spaces in between and scanty undergrowth, a typical habitat for flying squirrel Petaunista petaurista.



Plate 4.a. Male Gaur Bos gaurus, the largest herbivore of the study area.



Plate 4.b. Indian rock python Python molurus on the margin of thick and degraded forest in the Western Catchment.

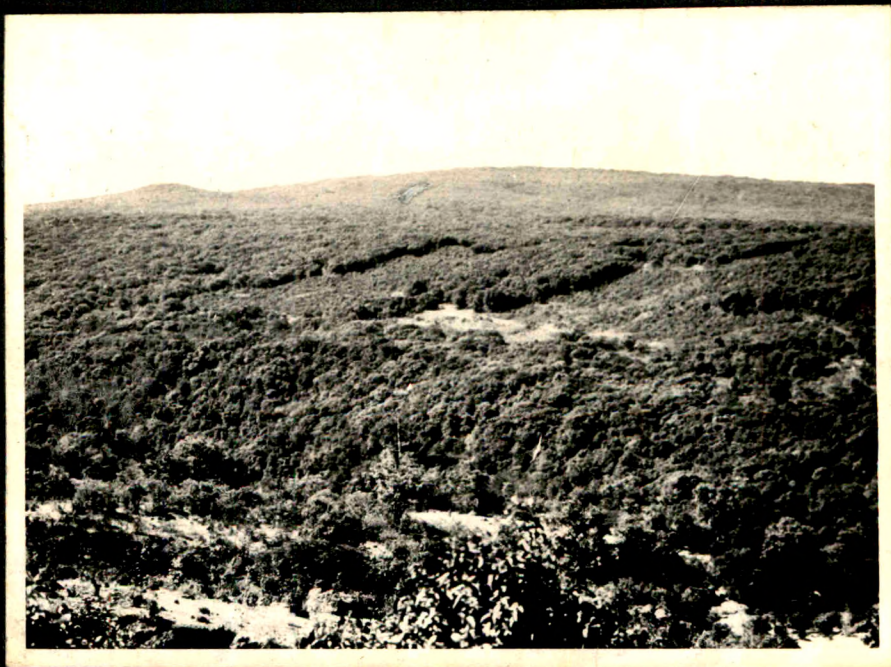


Plate 5.a. Deforestation in the Western Catchment
around Zadoli Ambeghar area.



Plate 5.b. Encroachments and truck routes made in the
old Shirsinge area for the transport of
illegally cut wood.

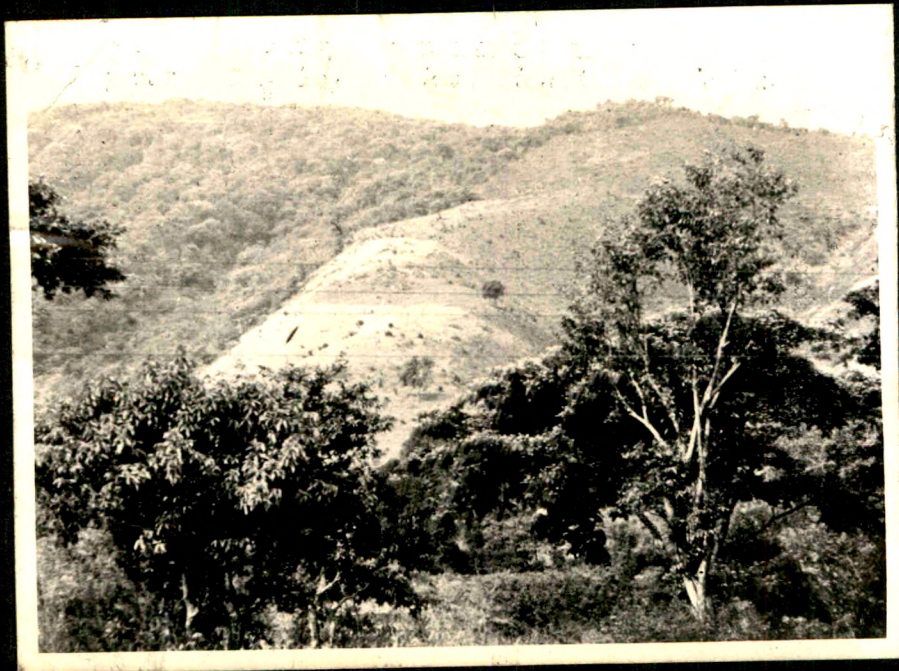


Plate 6.a. Clear felling of trees on the slopes in the Kusawade area in the eastern catchment.



Plate 6.b. Vegetation and trees being freshly destroyed on the major wild animal paths to waterhole.



Plate 7.a. Agriculture on the margin of dens forests, causing accute animal pest problem outside the catchment but in the Koyna Wildlife Sanctuary.

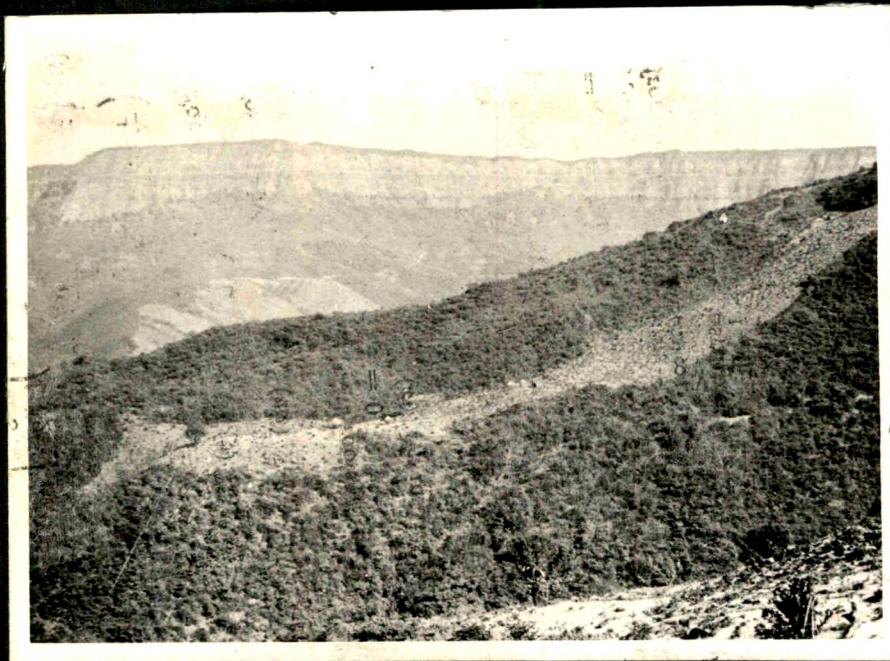


Plate 7.b. Traditional shifting cultivation practice on the steep slopes in the study area. Entire area belonging to one household.



Plate 8.a. Culturable wasteland or grazing land in the eastern catchment with degraded forest at background.



Plate 8.b. Terrace agriculture in the study area, completely devoid of original vegetation on the slopes.



Plate 9.a. New settlements in the study area with encroachments on Govt. forest lands in Shirshinge area.

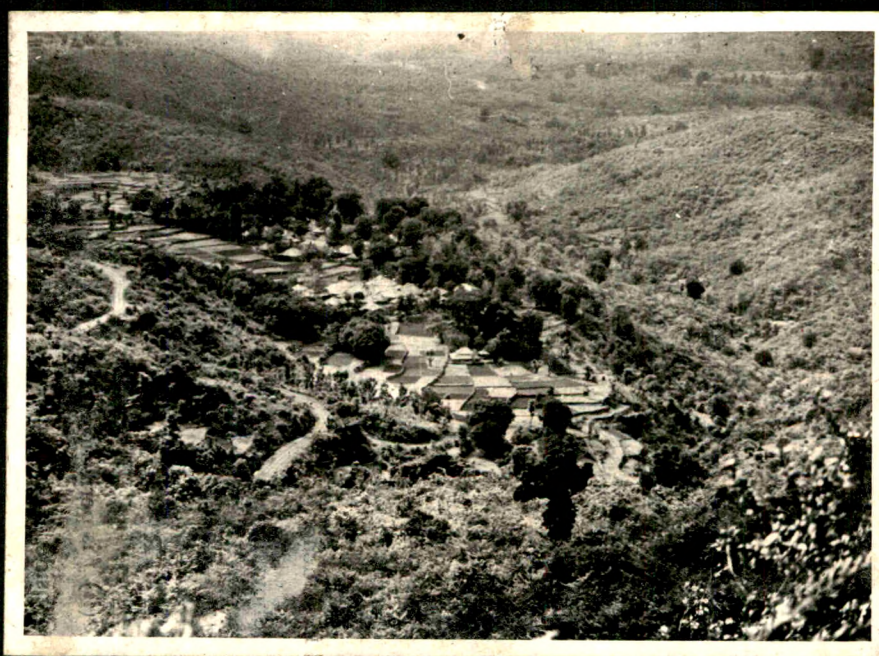


Table 9.b. A typical settlement in the study area note the degraded scrub surrounding and few fruit bearing trees in the village.



Plate 10.a. A herd of Dangi Cattle in the typical
alerf and compact formation in the
totally degraded area in the east
catchment.

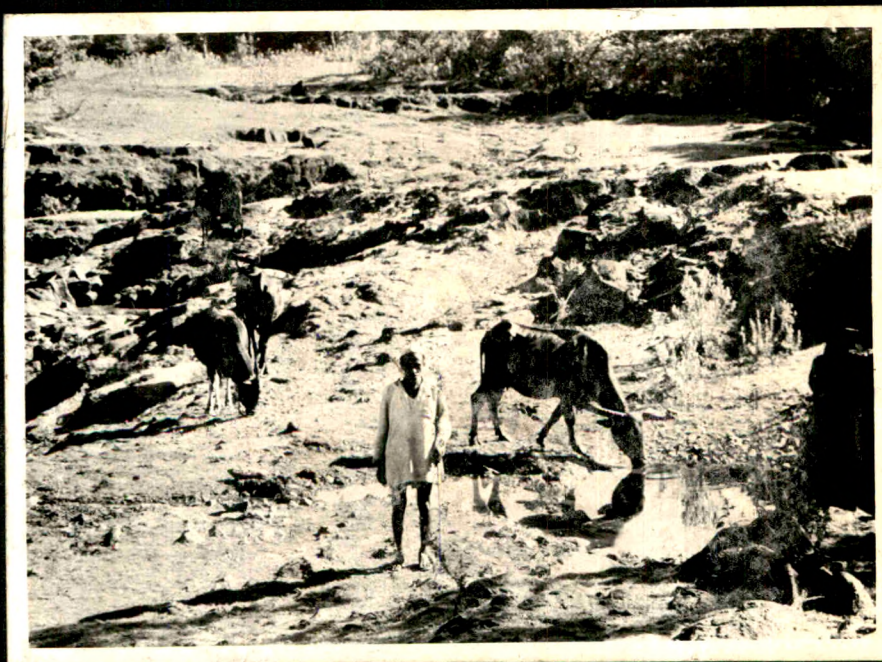


Plate 10.b. A Dhangar Gaoli with his buffaloes
at a waterhole on plateau in the
forested region in west catchment.



Plate 11.a. Increasing introduction of goats in the environs of the eastern catchment.

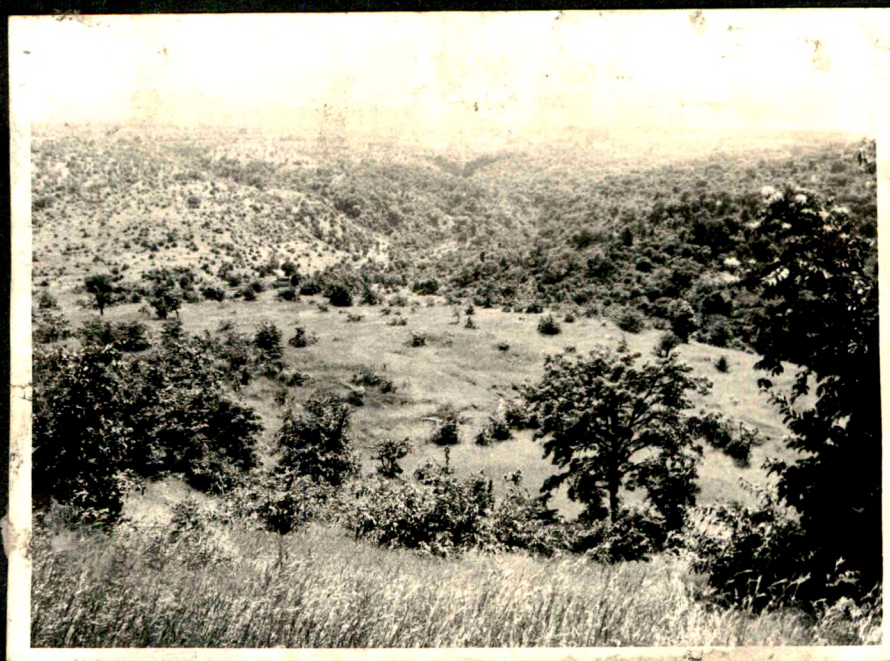


Plate 11.b. Beginning of degradation outside the Catchment in the study area, note the exposed land, scrub, waste land, grassland and degraded forest.

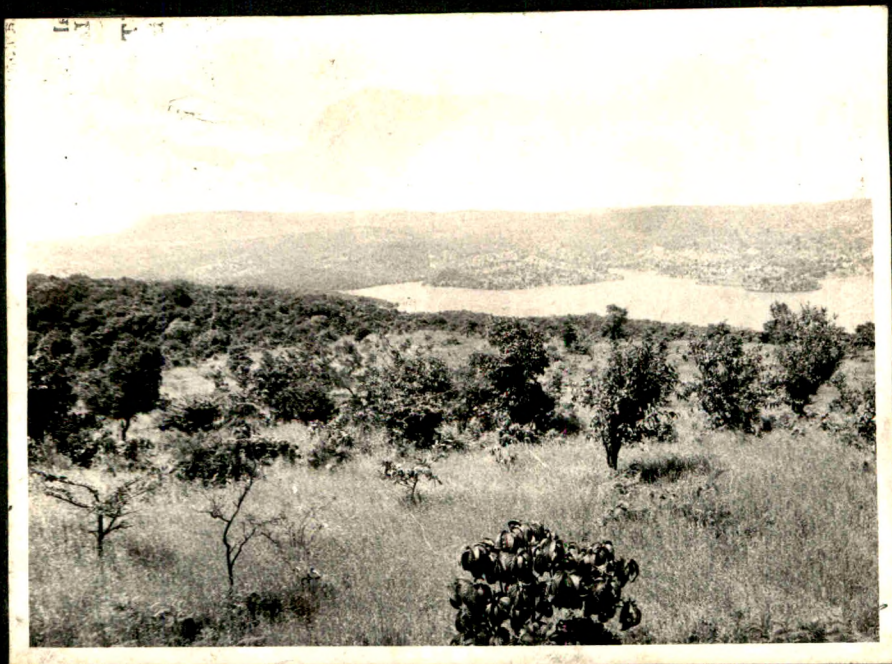


Plate 12.a. Fragmented secondary vegetation on the margins of wasteland.

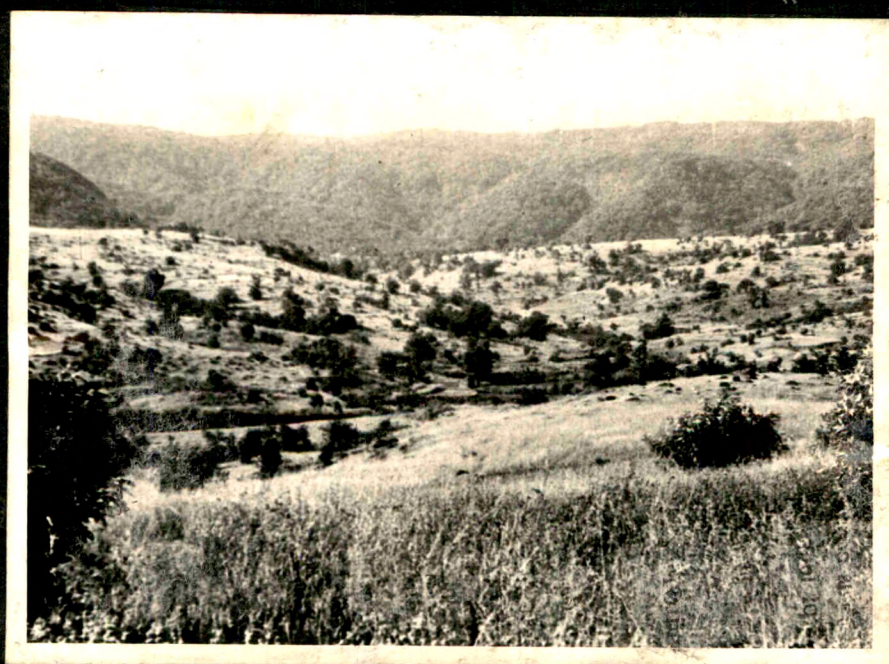


Plate 12b. Expansion of agriculture near the reservoir banks and settlement with the intact excellent forest on the slope and at the crest region at the background.

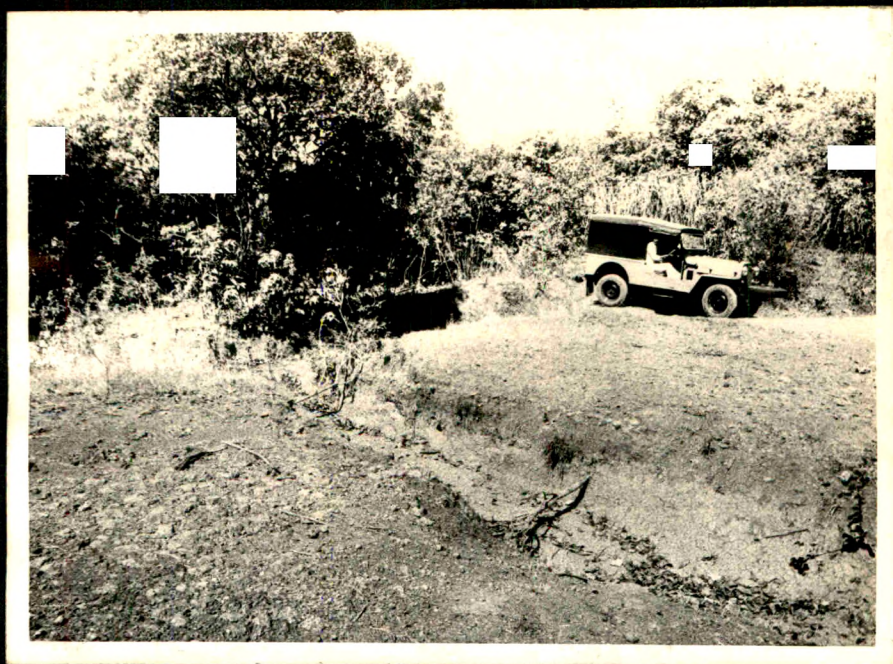


Plate 13.a. The crude and temporary roads made deep inside the eastern catchment to connect far off settlements.



Plate 13.b. Roads through good forests are often used to transport wood and at times for poaching.



Plate 14.a. The original climax evergreen forest in the high rainfall region of Koyna for which it was known.



Plate 14.b. The present state of Koyna catchment (eastern) the change is particularly in last the thirty years.