CHAPTER THREE

OBSERVATIONS

3.1 Rainfall

The annual rainfall of Koyna valley, the belt roughly 20-30 km wide and parallel to the crest of the main Sahyadri range is considerably higher than the neighbouring catchments in the Western Ghats. The climate of this region is broadly divided into four seasons. December to middle of February is the cold season. From February till the end of May is the hot season. June to September is the South-West monsoon season, and the two months of October and November forms the post monsoon season.

Thunder storms occur in the hot season and in the post monsoon months. The rainfall during the south-west monsoon is also sometimes accompanied with thunder. The hills are generally covered with clouds during the monsoon months. The mean annual rainfall in the short span of four months of monsoon is around 4666.6 mm and the mean number of rainy days is 105 per year.

The rainfall values in the north-south Koyna valley are regularly recorded at four stations namely Koyna, Navja, Valvan and Kathi. The first two are in the Western Catchment and the other two in the eastern catchment. It was interesting to study whether there is any change in the magnitude and distribution of rainfall in the Koyna valley since the beginning of dam construction, which has initiated large scale deforestation.

It must be noted that because of the unique feature of the Koyna Catchment, unlike all other major dam catchments in the region, both the sides of the river valley for 65 km length

are known to receive heavy rainfall. The valley being narrow and parallel to the west coast there is hardly any difference in its magnitude.

Closer scrutiny of the daily rainfall figures for last forty years in the region revealed interesting points. In order to compare the possible changes in rainfall values, pre-impoundment values at the four stations were compared with the recent values. For better comparision the range of maximum, minimum and mean values at all the four stations for a five year, period each for 1955-1960 and 1980-1985 were studied (Table No.2).

It was noticed that there has been gradual decrease in the number of rainy days at all the four stations, but this decrease is more in the later period i.e. 1980-1988 (Fig.4). Also the same downward trend was observed in the annual rainfall values which were almost uniform to the trend seen in the number of rainy days (Fig.5).

It was very interesting to note that at all the four stations the mean values for the periods 1955-60 were reduced significantly during the period 1980-85 (Table No.2). The maximum, minimum and mean annual rainfall values and the maximum, minimum and mean number of days of rainfall at each station reduced significantly in the span of twenty years. The average annual rainfall during 1955-60 was 5968.5 mm in 115 days which reduced to the mean of 4666.6 mm in 105 days in the period 1980-85. This means there was a loss of 1301 mm

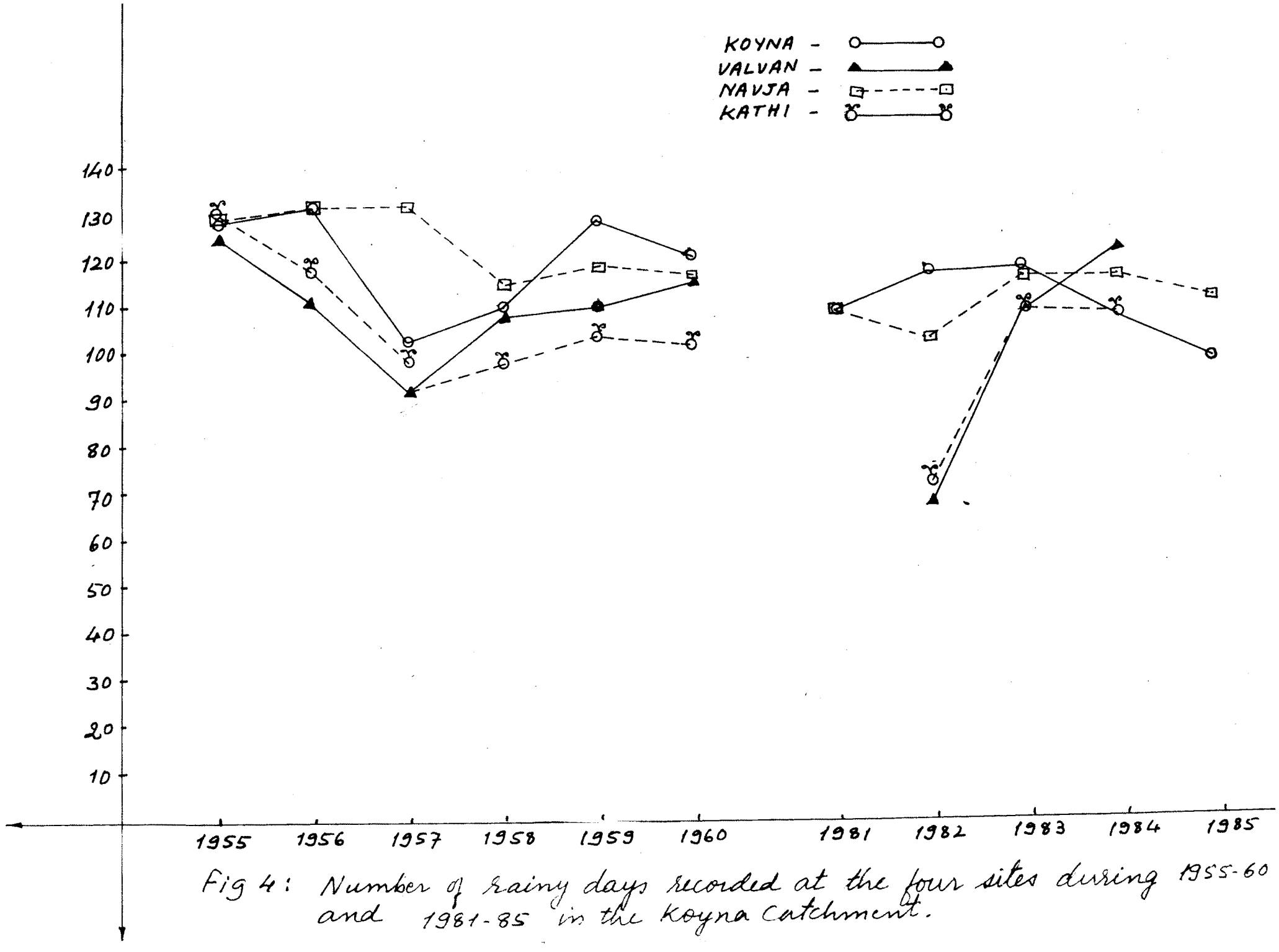

Fig 4: Number of rainy days recorded at the four sites during 1955-60 and 1981-85 in the Koyna catchment.

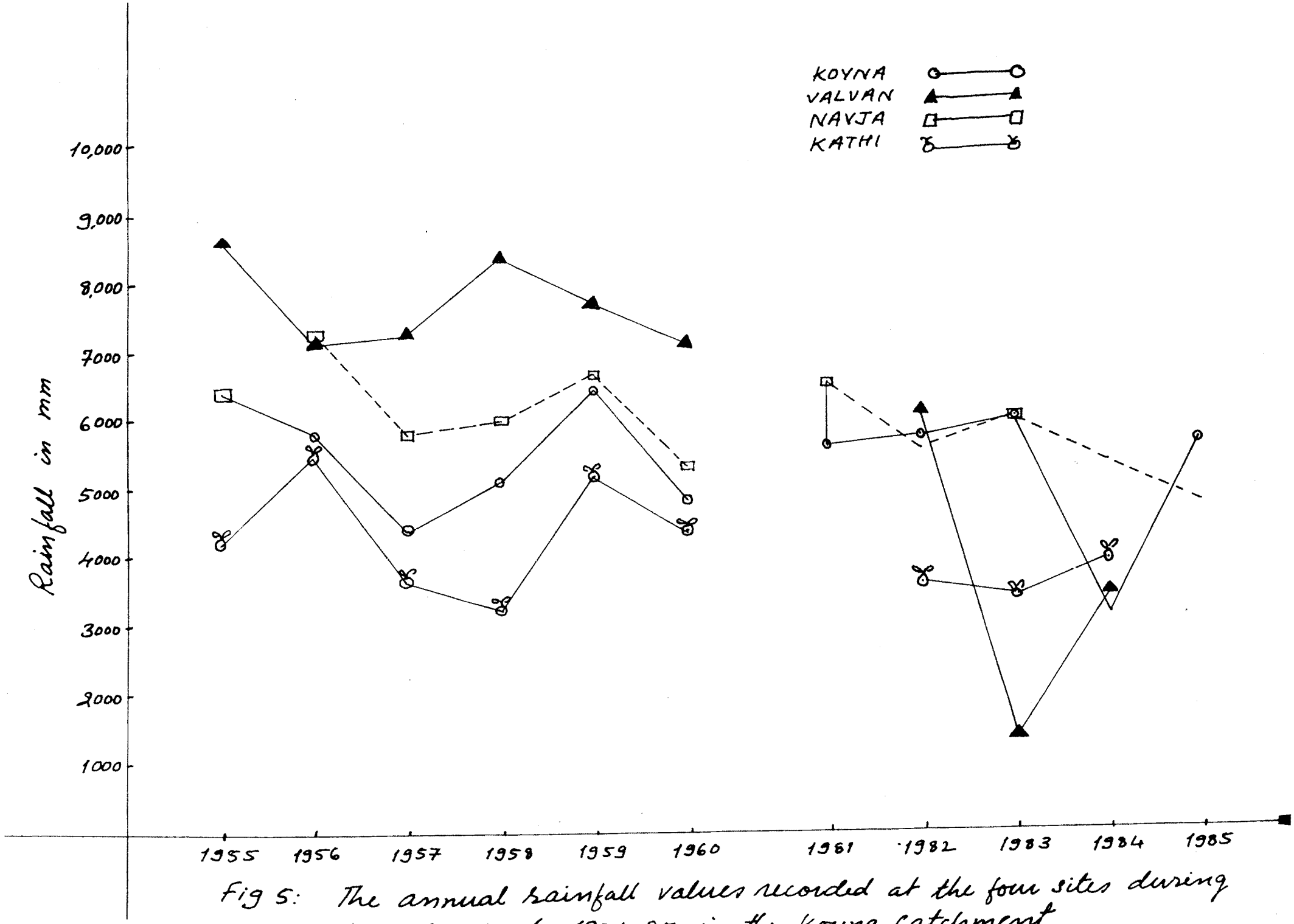

Fig 5: The annual rainfall values recorded at the four sites during [illegible] in the Koyna catchment.

rainfall and 10 rainy days. Also it is revealed that there is drastic fall in the values recorded in the eastern catchment as compared to the Western Catchment. Particularly at Valvan there is a drastic fall in annual rainfall values i.e. maximum, minimum and mean . The similar pattern was observed in the number of days of rainfall at the station.

The conclusions one is tempted to draw from these observations is - 1. There has been significant reduction in the annual rainfall in the Koyna catchment during last twenty years i.e. after the dam construction. 2. There has also been reduction in the number of days of rainfall which means longer drier period. 3. The negative change in the rainfall is more prominant in the eastern catchment where massive deforestation has taken place in the last three decades.

Though these observations are drawn on the basis of limited rainfall data of thirty years, the findings are striking and apparantly very convincing. Further studies are required to study the pattern of change of rainfall, its correlation with deforestation in the area, creation of reservoir etc.

3.2 Seismicity

It has only recently been recognised that the pressure applied to often fragile geological structures by the vast mass of water impounded by a big dam can, and often does, give rise to earthquakes.

The impoundment of water behind the dam, which resulted

in the formation of lake Shivaji Sagar, was initiated in 1962 and earth tremors were felt soon after. Three earthquakes of magnitude 5.8, 5.8 and 5.6 occured on 13th September, 1967 and these were followed by a disastrous seismic event of magnitude 7.0, on the ~~14~~ 11th December, 1967, which caused extensive damage and resulted in the death of about 200 persons and seriously injured 1500, and made thousands homeless.

A number of after schocks of magnitude greater than 4.0 were recorded during the next two years. Earthquakes, of magnitude 5.2 and 5.0 respectively, occured on 17th September, 1973 and 14th November, 1984. Altogether 39 earthquakes of magnitude 4.0, or greater, have been recorded since the commencement of water-impoundment. Seismic activity has extended over nearly two decades and during this period over 40,000 earth tremors have been recorded in the region (Pawar et al., 1986).

The review of seismicity data suggests that impoundment of water has been a causative factor for seismicity in the Koyna region. There has been a direct relationship between the water level and the frequency of the earthquakes. It is significant that seismic activity increased considerably when lake level reached 650 meters above MSL and was retained there for a fairly long time. The relationship between lake level, rate of change of lake level and magnitude of earthquakes at Koyna during the period 1964-1981 reveals an interesting relationship in terms of time-lag between peak reservoir load and strong seismic events. It has also been observed that the strong seismic events follow rapid rise in lake level (Patil & Guha, 1988).

There are no records of animal life being disturbed due to earthquakes from the Koyna area. Infact such attempts have never been made to try to study the impact of earthquakes or tremors on wildlife. However, it is worth trying to see what were the direct and indirect consequences of the earthquakes at Koyna on the wildlife in the study area. During the survey it was revealed that as a result of the earthquakes there were major fractures and land slides in the entire catchment along with loud noise. This might have caused great panic in the animals but the real picture is unknown. Many of the respondents still strongly believe that this is the main cause of the disappearance of the once common Chital, Axis axis from this region. Perhaps there was migration of the Chital herds outside the catchment area where there long term survival from poachers was not possible due to lack of vegetation cover. Though this could not possibly be confirmed.

The only known detrimental impact of the earthquakes on the animals was due to the total disappearance of water holes the perennial springs becoming seasonal, change in their locations and the reduction in the water flows. This has certainly affected the wild animals during adverse summer months.

The change in the availability of water and locations of the waterholes is expected to have made adverse impact on the distribution and diversity of at least larger mammals in the study area.

Some respondents also reported that the earthquakes resulted in birds leaving their habitats and nest sites,

reptiles coming out of the hiding places and animals leaving their territory in general. But if we consider the fact that the earthquakes had coincided with the rapid submergence of the Koyna Valley, it is difficult to say how many changes can really be attributed to earthquakes and how many to the submergence.

3.3 Submergence

The execution of an irrigation or a hydroelectric project need involve the loss of forest resources only in the submission areas. Apart from this, the creation of a large water body could positively help the other existing forests and wildlife. The nearly centu ry old reservoir on the Periyar river in the heart of the Thekkady Wildlife Sanctuary provides an example of this possibility. In the case of this reservoir, not even the submersion area was deforested and the ancient tree stumps stick out of the water to this date, providing excellent patches for the rich bird life of the area.

The wildlife too has benefit ed from the provision of a large-perennial water body. The forest cover in the vicinity has also been fairly well preserved. Unfortunately, it is not possible to site such examples from more recent times, where almost all projects seem to have had a devastating effect on the surrounding forest resources in a number of ways (Gadgil, 1981).

The Ist phase of Koyna Hydro-Electric Project submerged 11,535 hectares of mixed land under the impoundment in 1965.

This land included paddy fields, thick forests, wastelands, scrub land etc. A total of 9069 families from 98 villages were affected. In the IInd phase an addition of 167 ha of land was submerged and the number of households affected was 355 from 6 villages. The total catchments of both the stages comes to 916.18 sq km.

The rapid filling of the reservoir in order to commission the hydel project in time submerged vast forest tracts without giving any chance to the terrestrial and arboral fauna to escape submergence (Plate 1). The faunal destruction was not merely because of the submergence but also due to the non viable dispersal of the animals in other habitats. The water mass created an impossible barrier to many terrestrial and arboral species. The microfauna and sedentary population did not have any chance of survival so was the case of the arboral life like flying squirrel, hanuman langur, Indian Giant squirrel etc. Also due to the submergence of local migratory routes, habitat and feeding grounds, larger animal populations had also been affected. Shrinkage of habitat, increase in the population density in the given territory and loss of vegetation cover exposed many species to poaching and hunting resulting in the total destruction of animal diversity, species like Chital is a good example. These changes were profound particularly in the eastern catchment.

Table No.3, gives an idea about the changed status of the 28 villages in the study area. Out of these, 6 villages, though situated in the new Koyna Wildlife Sanctuary, are

outside the Koyna Catchment area and therefore their status is unchanged. Out of the 22 villages in the catchment only three villages namely Humbarli in the Western Catchment and Kati and Aral in the Eastern Catchment did not apparently get affected as they were situated on the hill slopes much above the level of dam submergance. Subsequently the land of village Humbarli was aquired for project purpose i.e for the Construction of Staff Colony.

Due to the reservoir 7 villages were fully submerged and they were rehabilitated out-side the catchment. About 12 villages were partially submerged i.e. either their land or settlements were submerged and they were accordingly partially rehabilitated outside the catchment.

However part of the population rehabilitated outside, returned in the catchment after some years and either settled at new places in forested regions or joined other settlements in the dam catchment (Plate 2).

It is interesting to observe the changing profile of the settlements in the study area. Table No.4 gives the profile of the study area in late fifties (1961) and twenty years after i.e. late seventies (1981) in all the 26 villages. Out of these Karanjawade, Rohine, Taloshi, Punawali, Deoghar and Dastan were completely vacated due to submergence. Whereas Humbarli and Gokul were developed as urban areas for project constructions.

The number of households reduced by 1135 thus decreasing

5431 individuals in the study area. Apparently there was also reduction in the number of individuals per household which changed from 4.27 individuals per household in 1961 to 4.03 per household in 1981. This change could be attributed to youth going out of the study area for education and employment as a result of improved facilities of communication and transportation.

After the dam construction the fertile cultivated lands in the river valley were submerged in the Shivaji Sagar reservoir. However, after twenty years there has been dramatic increase in the land under cultivation. Which changed from 704 ha (1961) to 3782 ha (1981) i.e. a net increase of 3078 ha. Opposite to this there was reduction in all the other three categories of lands in the study area namely not available for cultivation, culturable waste land and forest. The drop in the land not available for cultivation was reduced by 3234 ha, culturable waste land reduced by 10,976 ha and forest by 4236 ha. This decrease in the area around the settlements was mainly due to the agriculture expansion, shifting cultivation, deforestation and in general degradation of the catchment.

The area marked as not available for cultivation was the remote inaccessible area on the steep slopes, hill tops, and near escarpments. Due to over grazing, shifting cultivation even at the remote corner, due to fall in soil fertility resulted in its reduction of this land.

The culturable waste land was a basically a scrub land or fallow land. These areas were either own land or Govt. land and were not cultivated because of lack of man power need to

cultivate them. However, due to the submergence of fertile cultivated lands these scrub lands on the slopes were exploited for shifting cultivation, fuel wood extraction and at the end for agriculture expansion. This resulted in the degradation of the lands. Also these were acquired for settlements and encroached upon. The degradation is phenomenal in the eastern catchment where culturable waste lands were reduced to fractions of what they were before, namely in Kusawade village it changed from 2424 ha to 7.6 ha, in Gojegaon village from 1635 ha to 5.2 ha etc.

Basically reduction in forest land was from the owned forests. The main cause of the change were clear felling for timber and fuel wood, and shifting cultivation practices. Also the some forest on govt. lands was encroached upon. Similarly some Govt. lands were given to dam affected people in the upper catchments for resettlement purpose.

These changes in land compositions per village in the study area were not uniform but there was a clear cut difference in the change from eastern catchment, western catchment and settlements from outside the catchment area (Table 4b, fig.3).

The east catchment of Koyna reservoir in the study area is badly degraded region basically because it had better road facilities from beginning. Also it was closer to the tahasil place of Patan. Therefore this area witnessed more deforestation immediately after the dam construction. The villages in the catchment, namely Kusawade, Gojergaon, Aral etc. have larger population as compared to other settlements. Therefore the

larger population has also played an additional role in the degradation of this area, which has reduced other lands and at the same time increased cultivated lands.

In contrast to this there is not much change in non-culturable land in the west catchment. However there is significant reduction in the culturable waste land and forest land and increase in agriculture land.

Outside the catchment,villages in the study area the rather more representative of the prevalant trend of change in general, in the settlements in the hilly Western Ghats. This area represents much larger degradation of the forested area and culturable waste land with slight increase in the cultivated land (fig.3).

While studying the area for mammalian diversity interviews were conducted at every village, except in village Navja, out of the 21 villages in the study area attempts were made to cover more than 60 % of the households. Except in the case of Humbarli (3.33 %) which is a urban centre now,in other villages the targets were almost achieved.

Out of the total of 980 households in the study area i.e. Koyna Wildlife Sanctuary within the Koyna dam catchment and outside, but in Patan tahasil, 479 households i.e. 48.87 % were interviewed. But excluding the urban area of Humbarli near dam site the actual percentage of households surveyed comes to about 72 % i.e. much more than planned. Table No.5 gives the number of households, households surveyed and their percentage from

Table No.5 : Number and the percentage of households surveyed in each village of the study area.

Sr. No.	Name of the villages	Total Households	No.of Info Households	Info Households Percentage
1.	Nahimbe-Ambeghar	19	11	57.89
2.	Shirshinge	13	2	15.38
3.	Gojegaon	96	63	65.62
4.	Kathi	29	20	68.96
5.	Aral	34	18	52.94
6.	Kusawade	149	103	69.12
7.	Dicholi	51	33	64.70
8.	Zadoli	15	8	53.33
9.	Zadoli-Ambeghar	11	7	63.63
10.	Kisrule Mura	9	6	66.66
11.	Poonoli-Dhokawale	14	11	78.57
12.	Poonoli-Kisrule	11	7	63.63
13.	Mirgaon	39	34	87.17
14.	Kamargaon	74	56	75.67
15.	Humbarli (Urban)	330	11	3.33
16.	Gokul (Urban)	55	31	56.36
17.	Thorne	46	16	34.78
18.	Shiwandeshwar	25	14	56
19.	Ghatmatha	16	14	87.5
20.	Mendeghar	34	14	41.17
		980	479	48.87

each of the twenty villages from the study area.

3.4 Vegetation

The vegetation in the study area is mainly represented by tropical evergreen, subevergreen and moist and mixed deciduous type with climax stage in many areas, particularly in the Western Catchment. The area is known for the following plant species like Hardwickia, Bridella, Terminalia, Glochidion, Cacaria, Xylia, Randia, Grewia, Macaranga, Lagerstoemia, Lasiosphon, Actinodaphric, Artocarpus, Alstonia, Gmelina, Heteropharagma, Strobilanthes, Blumea, Zizyphus, Carissa etc.

During the investigations only the dominant plant species were recorded as the emphasis of the study was on mammals of the area. Together 102 plant species were listed (Table No. 6) out of which 81 were tree species, 12 shrubs, 5 climbers and 4 grasses. However this list is incomplete and very scanty, as this area has some patches with excellent tropical evergreen and semievergreen climax vegetation.

The forest department has planted exotic species like Eucalyptus, Silver Oak, Acacia, Casurina etc. over some areas in the catchment. The major forest produce in the area is firewood, timber and charcoal where as the minor forest produce is hirda, shikekai, apta, tembhurni leaves, cane, fruits etc.

Out of the 891.78 sq.km area of the catchment almost 490 sq.km is with the forest department and 480 sq.km with private owners. Inspite of being the catchment of a vital and sensitive dam [illegible] and part of the wildlife sanctuary,

Table No.6 : Check list of the common vegetation from the study area with local Marathi names.

Sr. No.	Botanical Name	Vernacular Name
	TREES	
1.	Albizzia odoratissima	Adul
2.	Morinda tinctoria	Al
3.	Vangueria spinosa	Alu
4.	Mangifera indica	Amba
5.	Hardwickia binata	Anjan
6.	Hemecylon edule	Anjani
7.	Bauhinia racemosa	Apta
8.	Terminalia arjuna	Arjun sadada
9.	Bridelia retusa	Asana
10.	Ficus arnottiana	Ashta
11.	Terminalia tomentosa	Ain
12.	Pittosporum floribundum	Atki or Yekkadi
13.	Phyllanthus emblica	Avala
14.	Acacia arabica	Babhul
15.	Aegle marmelos	Bel
16.	Terminalia belerica	Beheda
17.	Cassia fistula	Behava
18.	Cordia myxa	Bhokar
19.	Glochidion lanceolarium	Bhoma
20.	Amoora lawii	Bhoram
21.	Elexodendron glaucum	Bhutker

Table No. 6 (Contd..)

Sr.No.	Botanical Name	Vernacular Name
	TREES (Contd..)	
22.	Casearia gravealens	Bhokada
23.	Semacarpus anacardium	Biba or Bibva
24.	Pterocarpus marsupium	Bibla
25.	Diospyros assimilis	Bobadsa or Malya
26.	Lagerstroemia parviflora	Bomdara or Lendi
27.	Santalum album	Chandan
28.	Macaranga roxburghii	Chindada
29.	Tamarindus indica	Chinch
30.	Grewia tilixfalia	Dhaman
31.	Leea microphylia	Dinda
32.	Randia dumetarum	Gel or Gela
33.	Zizyphus xylopyra	Ghathor
34.	Machilus macrantha	Gulumb
35.	Rauwoffia densiflora	Hadkua
36.	Terminalia belerica	Hela
37.	Terminalia chebula	Hirda
38.	Acacia leucophlea	Hiwar
39.	Xylia xylocarpa	Jamba
40.	Murraya koenigii	Kadhinimb
41.	Stephegyme parvifolia	Kalamb
42.	Pongamia globra	Karanj
43.	Dilienia pentagyme	Karambel
44.	Same as Asana Bridelia sp.	Katak
45.	Ficus tsiakela	Kel

Table No. 6 (Contd..)

Sr.No.	Botanical Name	Vernacular Name
	TREES (Contd..)	
46.	Acacia catechu	Khair
47.	Terminalia paniculata	Kinjal
48.	Garcinda indica	Kokam
49.	Wrightia tinctoria	Kudi
50.	Sideroxylom tomentosum	Kumbhal
51.	Casearua tomentosa	Modi
52.	Bassia latifolia	Moha
53.	Lagerstroemia microsarpa	Nana
54.	Premna nimmoniana	Nrkya
55.	Melia azadirachta	Nimb
56.	Heynea trijuga	Nimbara
57.	Ficus rumphii	Pair
58.	Butea frondosa	Palas
59.	Erythrina indica	Pangara
60.	Olea dioica	Par Jambhul
61.	Carallia integerrima	Phanshi
62.	Artocarpus integrifolia	Phanas
63.	Pavetta indica	Phapti
64.	Ficus arnottiana	Pimpran
65.	Ficus religiosa	Pipal
66.	Actinodaphric hookeri	Pisa
67.	Lasiosiphon eriocephalus	Rametha
68.	Artocarpus hirsuta	Ranphanus
69.	Sapindus emarginata	Ritha
70.	Tectona grandis	Sag or Sagwan

Table No. 6 (Contd..)

Sr.No.	Botanical Name	Vernacular Name
	TREES (Contd..)	
71.	Boswellia serrata	Salai
72.	Alstonia scholaris	Satwin
73.	Bombax malabaricum	Shivari or Sawar
74.	Albizzia lebbek	Shiras
75.	Dalbergia lattifolia	Shisham
76.	Gmelina arborea	Shivan
77.	Diospyros melanoxylon	Temburni
78.	Ficus glomerata	Umbar
79.	Ficus bengalensis	Vad
80.	Kudia calycina	Warang
81.	Heterophragma roxburghii	Waras
	SHRUBS	
82.	Blumea amplectens	Burambi
83.	Colebrookia oppositifolia	Bamani
84.	Woodforidia floribunda	Dhayti
85.	Crotelaria retusa	Dingla
86.	Lantana camera	Ghaneri
87.	Carissa carandas	Karvand
88.	Strobilanthes callosus	Karvi
89.	Atalantia monophylla	Makad limbu
90.	Vitex negundo	Nirguri
91.	Rhus parvifolia	Pandharphalli
92.	Zizyphus rugosa	Toran
93.	Capparis zeylanica	Wagati

Table No. 6 (Contd..)

Sr.No.	Botanical Name	Vernacular Name
	CLIMBERS	
94.	Casalpinia sepiaria	Chilhar
95.	Scutia indica	Chimat
96.	Smilax macrophylla	Ghotwel
97.	Abrus precatorius	Gunj
98.	Acacia concinna	Shikekai
	GRASSES	
99.	Andropogon tricticeus	Bhale-kusal
100.	Andropogon pertusus	Chanya-marvel
101.	Andropogon contortus	Kusali
102.	Andropogon contortus	Marvel

there is significant exploitation of faunal wealth in the study area. Particularly the eastern catchment vegetation has faced severe degradation in the recent years on account of deforestation by fuelwood and timber contractors and local inhabitants alike. This has made qualitative and quantitative and adverse impact on the floral diversity of the region.

3.5 Fauna

During the present investigations on the animal diversity in the newly proposed Koyna Wildlife Sanctuary, emphasis was given on various aspects of mammalian diversity. Altogether 30 species belonging to 6 orders and 15 families were recorded. Table No.7a gives the taxanomic list of these mammalian species and the revised wildlife protection act schedule of Govt. of India in which they are included. Eight species namely Indian pangolin, sloth bear, Leopard Cat, Marbled Cat, Panther, Tiger, Mouse deer and Flying squirrel belong to schedule I. Seven species in Schedule II, Five species in Schedule III, nine species in Schedule IV and one species from Schedule V were recorded.

Here it must be made clear that those mammalian species which play significant role as predator or crop pest and has considerable human interaction were only studied. Otherwise this list could be increased much longer.

Though this region supports excellent avifauna belonging to hilly region and different catagories of forests (Samant, 1988) during the present investigations only the very common and

Table No.7a : Taxanomic list of the wild mammals studied in the Koyna Wildlife Sanctuary with their Schedule Status in the Wildlife Act 1980.

Sr. No.	Scientific Name	Common English Name	Schedule No. in Wildlife Act
	Order : Chiroptera		
	Sub-order : Megachiroptera		
	Family : Pteropidae		
1.	Pteropus giganteus	Fruit eating bat	V
	Order : Primates		
	Family : Cercopithecidae		
2.	Macaca radiata	Maked	II
3.	Presbytis entellus	Langur, Wanar	II
	Order : Pholidota		
	Family : Manidae		
4.	Manis crassicaudata	I.pangolin	I
	Order : Carnivora		
	Family : Canidae		
5.	Canius aureus	Jackal	IV
6.	Vulpes bengalensis	Bengal Fox	IV
7.	Cuon alpinus	Wild dog	II
	Family : Ursidae		
8.	Melursus ursinus	Sloth Bear	I
	Family : Mustelidae		
9.	Lutra perspicillata	Smooth coated Indian otter	II
	Family : Viverridae		
10.	Vivericula indica	Small Indian Civet	IV
11.	Paradoxurus hermaphroditus	Common Palm Civet	IV
12.	Herpestes edwardsi	Indian grey Mongoose	IV
13.	Herpestes auropunctuatus	Small Indian Mongoose	IV

Table No.7a (Contd..)

Sr. No.	Scientific Name	Common English Name	Schedule No. in Wildlife Act
	Family : Hyaenidae		
14.	Hyaena hyaena	Stripped hyaena	III
	Family : Felidae		
15.	Felius chaus	Jungle cat	IV
16.	Felius bengalensis	Leopard cat	I
17.	Felius marmorata	Marbeled Cat	I
18.	Panthera pardus	Panther	I
19.	Panthera tigris	Tiger	I
	Order : Artiodactyla		
	Family : Suidae		
20.	Sus scrofa	Wild boar	III
	Family : Traculidae		
21.	Traqulus meminna	Indian spotted cheverotwin	I
	Family : Cervidae		
22.	Muntiacus muntjack	Barking deer	III
23.	Axis axis	Spotted deer	III
24.	Cervus unicolor	Samber	II
	Family : Bovidae		
25.	Boselaphus tragocamelus	Blue bull	III
26.	Bos gaurus	Gaur	II
	Order : Lagomorpha		
	Family : Leporidae		
27.	Lepus nigricollis	Indian hare	IV
	Order : Rodentia		
	Family : Sciuridae		
28.	Funambulus palmarum	Three stripped palm squirrel	V
29.	Petaurista petaurista	Phillippensis Common Giant flying squirrel	I
30.	Ratufa indica	Giant squirrel	I
	Family : Hystricidae		
31.	Hystrix indica	Indian orested porcupine	IV

Table No.7b : Taxanomic list of Birds in the Koyna Wildlife Sanctuary.

Sr. No.	Scientific Name	English Name
	Order : Pelecaniformes	
	Family : Phalacrocoracidae	
1.	Phalacrocorax niger	Little Cormorant
	Order : Ciconiformes	
	Family : Ardeidae	
2.	Ardeola grayii	Pond Heron
3.	Bubulcus ibis	Cattle Egret
4.	Egretta alba	Large Egret
5.	Egretta intermedia	Smaller Egret
6.	Egretta gazetta	Little Egret
7.	Nycticorax nycticorax	Night Heron
	Order : Falconiformes	
	Family : Accipitridae	
8.	Elanus caeruleus	Blackwinged Kite
9.	Pernis ptilorhyncus	Honey Buzzard
10.	Milvus migrans	Pariah Kite
11.	Accipiter badius	Shikra
12.	Accipiter nisus	Sparrow-Hawk
13.	Butastur teesa	White-eyed Buzzard
14.	Spizaetus cirrhatus	Crested Hawk-Eagle
15.	Ictinaetus malayensis	Black Eagle
16.	Gyps indicus	Indian Longbilled Vulture
17.	Spilornis cheela	Crested Serpent Eagle

Table 7b : (Contd..)

Sr. No.	Scientific Name	English Name
	Order : Falconiformes (Contd..)	
	Family : Accipitridae (Contd..)	
18.	Pandion haliaetus	Osprey
	Family : Falconidae	
19.	Falco subbuteo	Hobby
20.	Falco chicquera	Redheaded Merlin
21.	Falco naumanni	Lesser Kestrel
	Order : Galliformes	
	Family : Phasianidae	
22.	Francolinus pictus	Painted Partridge
23.	Perdicula asiatica	Jungle Bush Quail
24.	Perdicula erythrorhyncha	Painted Bush Quail
25.	Gallus gallus	Red Jungle fowl
26.	Gallus sonneratii	Grey Juhgle fowl
27.	Pavo cristatus	Common Peafowl
	Order : Charadriiformes	
	Family : Charadriidae	
28.	Vanellus indicus	Redwattled Lapwing
	Family : Laridae	
29.	Sterna aurantia	Indian River Tern
30.	Sterna hirundo	Common Tern
	Order : Columbiformes	
	Family : Columbidae	
31.	Treron pompadora	Greyfronted Green Pigeon
32.	Treron phoenicoptera	Green Pigeon

Table 7b : (Contd..)

Sr. no.	Scientific Name	English Name
	Order : Columbiformes (Contd..) Family : Columbidae (contd..)	
33.	Ducula aenea	Green Imperial Pigeon
34.	Columba livia	Blue Rock pigeon
35.	Columba elphinstonii	Nilgiri Wood Pigeon
36.	Streptopelia decaocto	Indian Ring Dove
37.	Streptopelia senegalensis	Little Brown Dove
38.	Chalcophaps indica	Emerald Dove
	Order : Psittaciformes Family : Psittacidae	
39.	Psittacula eupatria	Alexandrine Parakeet
40.	Psittacula krameri	Roseringed Parakeet
41.	Psittacula cyanocephala	Blossomheaded Parakeet
	Order : Cuculiformes Family : Cuculidae	
42.	Cuculus varius	Common Hawk-Cuckoo
43.	Cacomantis merulinus	Indian Plaintive Cuckoo
44.	Eudynamys scolopacea	Koel
	Order : Strigiformes Family : Strigidae	
45.	Otus bakkamoena	Collared Scops Owl
46.	Bubo bubo	Great Horned Owl
47.	Bubo nipalensis	Forest Eagle-Owl
48.	Glaucidium radiatum	Jungle Owlet
49.	Athene brama	Spotted Owlet
	Order : Caprimulgiformes Family : Caprimulgidae	
50.	Caprimulgus indicus	Indian Jungle Nightjar

Table 7b : (Contd..)

Sr. No.	Scientific Name	English Name
	Order : Apodiformes	
	Family : Apodidae	
51.	Apus melba	Alpine Swift
52.	Apus affinis	House Swift
53.	Cypsiurus parvus	Palm Swift
	Sub-Family : Hemiprocninae	
54.	Hemiprocne longipennis	Crested Swift
	Order : Coraciiformes	
	Family : Alcedinidae	
55.	Ceryle rudis	Lesser Pied Kingfisher
56.	Alcedo atthis	CommonkKingfisher
57.	Pelargopsis capensis	Storkbilled Kingfisher
58.	Halcyon smyrnensis	Whitebreasted Kingfisher
	Family : Meropidae	
59.	Merops orientalis	Green Bee-eater
	Family : Coraciidae	
60.	Coracias benghalensis	Indian Roller
	Family : Bucerotidae	
61.	Tockus birostris	Common Grey Hornbill
	Order : Piciformes	
	Family : Capitonidae	
62.	Megalaima zeylanica	Green Barbet
63.	Megalaima viridis	Small Green Barbet
64.	Megalaima rubricapilla	Crimsonthroated Barbet
65.	Megalaima haemacephala	Crimsonbreasted Barbet

Table 7b (Contd..)

Sr. No.	Scientific Name	English Name
	Order : Piciformes (Contd..)	
	Family : Picidae	
66.	Micropternus brachyurus	Rufous Woodpecker
67.	Dinopium benghalense	Lesser Goldenbacked Woodpecker
68.	Dinopium javanense	Indian Goldenbacked Threetoed Woodpecker
69.	Dryocopus javensis	Indian Great Black Woodpecker
70.	Picoides mahrattensis	Yellowfronted Pied Woodpecker
71.	Chrysocolaptes lucidus	Larger Goldenbacked Woodpecker
	Order : Passeriformes	
	Family : Pittidae	
72.	Pitta brachyura	Indian Pitta
	Family : Alaudidae	
73.	Galerida deva	Sykes's Crested Lark
	Family : Hirundinidae	
74.	Hirundo concolor	Dusky Crag Martin
75.	Hirundo rustica	Swallow
	Family : Oriolidae	
76.	Oriolus chinensis	Blacknaped Oriole
77.	Oriolus xanthornus	Blackheaded Oriole
	Family : Dicruridae	
78.	Dicrurus adsimilis	Black Drongo
79.	Dicrurus aeneus	Bronzed Drongo
80.	Dicrurus paradiseus	Greater Racket-tailed Drongo

Table 7b (Contd..)

Sr. No.	Scientific Name	English Name
	Order : Passeriformes (Contd..)	
	Family : Sturnidae	
81.	Acridotheres fuscus	Jungle Myna
82.	Gracula religiosa	Grackle or Hill Myna
	Family : Corvidae	
83.	Depdrocitta vagabunda	Indian Tree Pie
84.	Corvus splendens	House Crow
85.	Corvus macrorhynchos	Jungle Crow
	Family : Campephagidae	
86.	Coracina melanoptera	Blackheaded Cuckoo-Shrike
	Family : Irenidae	
87.	Aegithina tiphia	Common Tora
88.	Chloropsis aurifrons	Goldfronted Choloropsis
89.	Irena puella	Fairy Bluebird
	Family : Pycnonotidae	
90.	Pycnonotus jocosus	Redwhiskered Bulbul
91.	Pycnonotus cafer	Redvented Bulbul
92.	Hypsipetes madagascariensis	Black Bulbul
	Sub-Family : Timaliinae	
	Family : Muscicapidae	
93.	Chrysomma sinensis	Yelloweyed Babbler
94.	Turdoides caudatus	Common Babbler
95.	Turdoides striatus	Jungle Babbler
96.	Turdoides affinis	Whiteheaded Babbler
97.	Alcippe poioicephala	Quaker Babbler

Table 7b (Contd..)

Sr. No.	Scientific Name	English Name
	Sub-Family: Muscicapinae	
98.	Muscicapa parva	Redbreasted Flycatcher
99.	Muscicapa pallipes	Bluethroated Flycatcher
100.	Muscicapa tickelliae	Tickell's Blue Flycatcher
101.	Muscicapa thalassina	Verditer Flycatcher
102.	Terpsiphone paradist	Paradise Flycatcher
103.	Monarcha azurea	Blacknaped Flycatcher
	Sub-Family : Sylviinae	
104.	Cisticola juncidis	Streaked Fantail Warbler
105.	Prinia socialis	Ashy Longtail Warbler
106.	Prinia sylvatica	Jungle Longtail Warbler
107.	Acrocephalus agricola	Paddyfield Warbler
108.	Phylloscopus affinis	Tickell's Leaf Warbler
	Sub-Family : Turdinae	
109.	Copsychus saularis	Magpie-Robin
110.	Saxicola caprata	Pied Bush Chat
111.	Saxicoloides fulicata	Indian Robin
112.	Monticola cinclorhynchus	Blueheaded Rock Thrush
113.	Monticola solitarius	Blue Rock Thrush
114.	Myiophoneus horsfieldii	Malabar Whistling Thrush
115.	Zoothera citrina	Orangeheaded Ground Thrush
116.	Turdus unicolor	Tickell's Thrush
117.	Turdus merula	Blackbird
	Family : Paridae	
118.	Parus major	Grey Tit

Table 7b (Contd..)

Sr. No.	Scientific Name	English Name
	Family : Sittidae	
119.	Sitta castanea	Chestnutbellied Nuthatch
	Family : Motacillidae	
120.	Anthus trivialis	Tree Pipit
121.	Anthus novaeseelandiae	Paddyfield Pipit
122.	Motacilla indica	Forest Wagtail
	Family : Dicaeidae	
123.	Dicaeum agile	Thickbilled Flowerpecker
124.	Dicaeum erythrorhynchos	Tickell's Flowerpecker
	Family : Nectariniidae	
125.	Nectarinia zeylonica	Purplerumped Sunbird
126.	Nectarinia asiatica	Purple Sunbird
	Family : Zosteropidae	
127.	Zosterops palpebrosa	White-eye
	Family : Ploceidae	
128.	Passer domesticus	House Sparrow
	Sub-Family: Ploceinae	
129.	Ploceus philippinus	Baya
	Sub-Family: Estrildinae	
130.	Estrilda amandava	Red Munia
131.	Lonchura malabarica	Whitethroated Munia
132.	Lonchura punctulata	Spotted Munia
133.	Lonchura malacca	Blackheaded Munia

Table 7b (Contd..)

Sr. No.	Scientific Name	English Name
	Family : Fringillidae Sub-Family: Carduelinae	
134.	Carpodacus erythrinus	Common Rosefinch
	Family : Emberizidae	
135.	Emberiza bruniceps	Redheaded Bunting
136.	Melophus lathami	Crested Bunting

Table No.7c : Taxanomic list of the Reptiles recorded in the Koyna Wildlife Sanctuary.

Sr. No.	Scientific Name	English Name
	Order : TESTUDINES	
	Family : Emydidae	
1.	Geomyda trijuga (Schweigger)	Pond Tortoise
2.	Kachuga tectum tentoria (Gray)	Pond Tortoise
	Order : SQUAMATA	
	Sub order : Sauria	
	Family : Eublepharidae	
3.	Calotes rouxi Dum & Bibr	Forest Calotes
	Family : Lacertidae	
4.	Varanus bengalensis (Daudia)	Common Monitor
	Sub order : Serpentes	
	Family : Typhlopidae	
5.	Typhlops braminus (Daudin)	Blind snake
	Family : Boidae	
6.	Python molurus (Linnacus)	Indian python
	Family : Colubridae	
7.	Elaphe helena (Linnaeus)	Trinket snake
8.	Ptyas mucosus (Linnacus)	Snake Rat
9.	Lycodon aulicus (Linnacus)	Common Wolf snake
10.	Xenochrophis piscator (Schneider)	Checkered Keelback
11.	Amphiesma stolata (Linnaeus)	Striped Keelback
12.	Ahaetulla nasutus (Inacepede)	Common Green whip snake
	Family : Elapidae	
13.	Bungarus caeruleus(Schneider)	Common Indian Krait
14.	Naja Naja (Linnaeus)	Indian Cobra
15.	Ophiophagus hannah (Cantor)	King Cobra (Hamadryad)
	Family : Viperidae	
16.	Vipera russelli (Shaw)	Russell's Viper
17.	Echis carinatus (Schneider)	Saw-scaled Viper

Table No. 7d : Taxanomic List of the Fishes in the Koyna reservoir.

Sr No.	Scientific Name	English Name	Local Name
	Order : CYPRINIFORMES Sub-order : Cyprinoidei Family : Cyprinidae		
1.	Oxygaster bacaila	Chilwa	Alkut,
2.	Oxygaster boopis (Day)	Chilwa	Alkut, Amli
	Sub-Family: Rasborinae		
3.	Danio aequipinnatus (McClelland)	Great danio	Balooki
	Sub-Family: Cyprininae		
4.	Aspidoparia morar (Hamilton)	-	Amlee
5.	Tor khudree (Sykes)	Mahseer	Mhasheer Khadra Khadashi
6.	Tor mussulah (Sykes)	Mahseer	Mhasheer Mhaslya
7.	Puntius arenatus (Day)	Barh	Khavli
8.	Puntius kolus (Sykes)	Kolshi	Kolhsi
9.	Catla catla (Hamilton-Buchanan)	Catla	Catla
10.	Cirrhina Fulungee (Sykes)	Carp	Mulicha ganna
11.	Cirrhina mrigala (Hamilton)	Mrigal	Mrigal
12.	Labeo fimbriatus (Bloch)	Coller carp	Tambir
13.	Labeo porcellus (Heckel)	Carp	Tambudki
14.	Garra mullya (Hamilton)	Stone Sucker	Mallya
15.	Schismatorhynchus (Nukta) nukta (Syker)	Nakta	Nakta
16.	Osteobrama cotio (Hamilton)	-	Bhongi
17.	Osteobrama vigorsii (Sykes)	-	Phankut
18.	Lepidocephanus guntea (Hamilton)	Lesser loach	Mori
19.	Nemacheilus botia (Hamilton)	Striped loach	Chikli
20.	Botia striata Var.	Tiger loach	Wagh masa
	Sub-Order : Siluriidei Family : Siluridae		
21.	Wallago attu (Bloch and Schneider)	Fresh water Shark, Wolly	Valashivda, Padin Shivda

Table No.7d (Contd..)

Sr No.	Scientific Name	English Name	Local Name
	Family : Schilbeidae		
22.	Neotropius khavalchor Kulkarni	Cat fish	Khavalchor
	Family : Bagridae		
23.	Rita kuturnee (Sykes)	Cat fish	Katarnee
24.	Mystus aor (Hamilton)	Cat fish	Shingala
25.	Mystus molabaricus (Jerdon)	Cat fish	Shingti
	Family : Sisordae		
26.	Bagarius bagarius (Hamiton)	Giant banded cat fish	Khirit
	Family : Anguillidae		
27.	Anguilla anguilla (Hamilton)	Fresh water eel	Aheer
	Order : BELONIFORMES		
	Sub-Order : Scombersocoidei		
	Family : Beionidae		
28.	Xenentodon cancila (Hamilton-Buchanan)	Fresh water gar fish	Tokali, Kutra masa.
	Order : OPHIOCEPHALIFORMES		
	Family : Ophiocephalidae (Channidae)		
29.	Channa gachua (Hamilton)	Dwarf murrel or dwarf snake head fish	Dokrya, Daku, Dhok
30.	Channa marulius (Hamilton)	Murrel or snake head fish	Kala masa, Maral
	Order : PERCIFORMES		
	Sub-Order : Percoidei		
	Family : Ambassidae		
31.	Ambassis baculis (Hamilton-Buchanan)	Glass fish	Kachki Chembardi
	Order : MASTACEMBELIFORMES		
	Family : Mastacembelidae		
32.	Mastacembelus pancalus (Hamilton)	Fresh water ell	Vam, Vambat.

prominant bird species were recorded. The taxanomic list of which is given in table no. 7b.

Similarly thirteen species of reptiles (Table No.7c) were recorded from the study area. However, it was not possible to get information about the birds and reptiles from the local inhabitants as they did not appear to have any interest and information about animals other than ones very prominant like hornbill, useful like jungle fowl or venomus like Viper or Cobra.

The list of fishes found the Shivsagar reservoir and nearby streams was comparatively more accurate because the fishes could be collected studied and identified in laboratory. The list of fishes given in the table no.7d is based on the actual fish catch analysis. Due to the paucity of funds and non-availability of man power experimental fishing could not be conducted to study fish diversity from upstreams and remote areas.

3.6 Animal Diversity

Attempts were made to study the village wise status of 30 mammalian species around each village from the study area (Table No.8). The information provided by the villagers about the status of each one of the species studied was confirmed by separate observations of signs, scat, pugmarks, signtings etc. The past status was considered as common, uncommon, rare and absent. The species recorded as absent today were known to exist in the area few years ago. Table no.8a gives the past and

Table No.8a : List of the mammals and their past and present status in the Koyna Wildlife Sanctuary.

Sr. No.	Scientific Name	English Name	Status	
			Past	Present
1.	Macaca radiata	Bonnet macaque	C	C
2.	Presbystis entellus	Common Langur	C	U
3.	Manis crassicaudata	I.Pangolin	C	R
4.	Canis aureus	Jackal	U	R
5.	Vulpes bengalensis	I. Fox	C	C
6.	Cuon alpinus	Wild dog	C	C
7.	Melursus ursinus	Sloth bear	C	U
8.	Lutra perspicillata	I. Otter	C	R
9.	Virriola indica	Small Indian Civet	C	C
10.	Paradoxurus hermaphroditus	C.Palm Civet	C	C
11.	Herpestes edwardsi	Common mongoose	C	C
12.	Hyaena hyaena	Striped Hyena	C	R
13.	Felis chaus	Jungle Cat	C	C
14.	Felis bengalensis	Leopard Cat	C	R
15.	Felis rubiginosa	Rusty spotted Cat	C	A
16.	Panthera pardus	Leopard	C	C
17.	Panthera tigris	Tiger	C	R
18.	Sus scrofa	Wild boar	C	C
19.	Tragulus meminna	Mouse deer	C	R
20.	Muntiacus muntjak	Barking deer	C	C
21.	Axis axis	Chital	C	R
22.	Cerbus unicolor	Sambar	C	C
23.	Tetracerus quadricornis	Four horned antelope	C	A
24.	Boselaphus tragocamelus	Nilgai	C	A
25.	Bos gaurus	Gaur	C	C
26.	Lepus nigricollis	I. Hare	C	C
27.	Petaurista petaurista	Giant Flying Squirrel	U	R
28.	Funanbulus palmarum	Three striped squirrel	C	C
29.	Funambulus pennanti	Five stripped squirrel	C	U
30.	Ratufa indica	I. Giant Squirrel	C	C
31.	Hystrix indica	I. Crested Porcupine	C	C

present status of 30 wild mammalian species found in the vicinity of the twenty villages in the study area (Plate 3&4).

Out of these only 18.33 % are now considered as common species which include wild boar, Barking deer, mouse deer and Hare. Most of the earlier common species have become uncommon or only occassionaly reported though this group is represented by almost 27 species the dominant are very few i.e. Pangolin, Porcupine etc. The percentage of this group is around 24.16 % among the four catagories (Table No.9).

There are about 35.33 % of the mammals in the study area which could be considered as rare which includes primates, fox, Leopard Cat, Panther, Common Otter, etc. About 21.33 % of species are no more recorded in the area where they were known earlier. This reveals that the distribution of these animals has been reduced significantly during recent years. This could be attributed to several factors like submergance of forest habitat and local migration routes due to the impoundment, deforestation, agriculture expansion and forest fragmentation resulting from it, continuous pressure of poaching etc.

Depending on these factors the distribution of mammals is obviously not uniform as before. Table No.10, reveals the status of mammals around each of the villages. Now 18.05 % species are commonly recorded, 23.05%are uncommon and 35.96 % have become rare and 20.96 % are absent. This clearly gives the trend of the degradation of the mammalian diversity of the study area.

Table No.9 : Present status of the important mammals in the Koyna Catchment.

Sr.No.	Mammals	Common	Uncommon	Rare	Absent
1.	Bonnet macaque	--	20	60	20
2.	Langur	--	25	65	10
3.	Jackal	10	35	50	5
4.	Wolf	--	5	30	65
5.	Fox	0	0	70	30
6.	Tiger	25	40	20	15
7.	Panther (Karada)	0	5	60	35
8.	Panther (Black)	0	5	65	30
9.	Leopard cat	5	15	65	15
10.	Jungle cat	30	35	35	0
11.	Mongoose	40	40	20	0
12.	Palm civet	0	5	40	55
13.	Small Indian Civet	0	45	55	0
14.	Common Ootter	10	15	60	15
15.	Wild dog	10	45	35	10
16.	Hyna	5	5	35	55
17.	Bear	30	25	35	10
18.	Pangolin	5	65	25	5
19.	Porcupine	20	55	10	5
20.	Gaint Squirrel	5	35	45	15
21.	Three Striped Squirrel	0	15	65	20
22.	Wild Pig	80	20	0	0
23.	Barking deer	85	15	0	0
24.	Barking deer Sp.	5	30	50	15
25.	Mouse deer	50	25	25	0
26.	Samber	45	35	15	5
27.	Spotted deer	0	0	5	95
28.	Gaur	30	35	5	30
29.	Hare	60	30	5	5
30.	Bat	0	0	10	90
	%	18.33	24.16	35.33	21.33

Table No.10 : Status of mammals around villages in the study area.

Sr. No.	Villages	Common	Uncommon	Rare	Absent
1.	Nahimbe-Ambeghar	12.90	19.35	19.35	48.38
2.	Shirshinge	0.00	32.25	0.00	67.74
3.	Gojegaon	12.90	22.58	45.16	19.35
4.	Kathi	16.12	25.80	41.93	16.12
5.	Aral	12.90	29.03	41.93	16.12
6.	Kusawade	16.12	22.58	45.16	16.12
7.	Dicholi	29.03	32.35	29.03	9.67
8.	Zadoli	29.03	9.67	29.03	32.25
9.	Zadoli-Ambeghar	25.80	38.70	22.58	12.90
10.	Kisrule-Mura	35.48	25.80	12.90	25.80
11.	Punooli-Dhokawale	16.12	25.80	45.16	12.90
12.	Punooli-Kisrule	32.25	35.48	6.41	25.80
13.	Mirgaon	19.35	25.80	41.93	12.90
14.	Kamargaon	3.22	32.25	58.06	6.41
15.	Humbarli (Urban)	32.25	22.58	29.03	16.12
16.	Gokul (Urban)	19.35	6.41	58.06	16.12
17.	Thorne	22.58	16.12	48.36	12.90
18.	Shiwandeshwar	9.67	19.35	41.93	29.03
19.	Ghatmatha	6.41	35.48	45.16	12.90
20.	Mendeghar	6.67	22.58	58.06	9.67
		18.05	23.05	35.96	20.96

When the villages were grouped into three catagories i.e. 1. East catchment (which is badly degraded), 2. West Catchment, having excellent forest and 3. Outside the catchment with fragmented forest area. The following picture emerged the eastern catchment had only 11.82 % species as common as compared to 23.78 % and 17.82 % in western catchment and outside the catchment respectively. There was not much difference in the uncommon species i.e. east (25.26 %), west (28.23 %) and outside (20.33 %). But in the rare species outside area had more i.e. (46.66 %) as compared to the other two zones, east (32.25 %) and west (30.65 %) respectively. As expected the absent species were maximum (30.58 %) in east zone, followed by outside (16.12 %) and lastly by Western Catchment (13.33 %).

3.7 Deforestation

In the last few decades the entire Western Ghats region has been over exploited of its forest resources. The ever increasing human pressure for timber, fuelwood, forest products, agricultural expansion and traditional unscientific agricultural methods like 'slash and burn' and 'Rab' are some of the main factors for degradation of the evergreen and semievergreen forests. The study area is no exception to these pressures. In addition to this charcoal making is one of the characteristic activities of the Koyna catchment. Submergence of the low land forests in the dam impoundment has reduced some of the age old climax forest system. The problems of deforestation have

aggravated by improved and new roads in the difficult terrain and uncontrolled grazing practice of the area

It was noticed that the exploitation of the forest was dependent on the human need and habits rather than the population density in the village and its distance from the nearby forest. Whereever good natural vegetation was intact the villages in the vicinity had higher crop yields due to the better human conditions in the soil and perennial water supply through the live springs. These conditions were particularly seen in the west catchment.

Therefore good vegetation and perennial water supply are non seperable and extremely important factors to maintain the local carrying capacity for humans as well as widelife. The degradation of natural vegetation for any reason has been found to be detrimental to the wild animals rather than the poaching pressure on them. The habitat reduction or destruction affects the population density of wild animals, creates food scarcity, cuts off local migration routes, destroy shelter and vital protection, creates water shortage and makes the wild animals more vulnerable to poaching thus drastically reducing their survival chances.

It is often reported that the fuel wood is extracted during shifting cultivation operations and significant amount from this is made available to industry and urban domestic consumption through outside wood contractors. However, it was observed during the field surveys that, in the remote areas, where often the land boundries are not clear, encroachment on

government forest land was a common practice. Particularly during the study period massive deforestation was under way in the dense forested area in the west catchment near Zadoli village (Plate 5a & b). Regular labour camp was established for hundreds of workers from outside the catchment and trucks were carried on rafts through the reservoir to transport the wood. It is needless to say that such large scale tree cutting operations in the already declared wildlife sanctuaries core area would certainly destroy the remaining animal diversity of the sensetive area. Also the creation of reservoir had not posed any difficulty to the illicit wood transport.

Though the villages in the study area are small and scattered they exert significant pressure on the forest wealth. The local population heavily depends on the forest resource for its subsistance. The table no. 11 reveals that 87 % people depend for fuel wood, timber (73 %), fruits (54.4 %) and other forest produce like barks, honey, bamboo etc.

The average fuel wood requirement of every household of six individuals for domestic purpose was studied during investigation (Table No.12). It was revealed that more than 99.20% of the households were dependent on wood for cooking, heating water and also for agriculture purpose and only 17.9 % households used cowdung, particularly for cooking purpose. It was striking to note that only 0.6 % of the households used dried twigs and none used agriculture waste as fuel. All the fuel wood requirements were obviously met by the neighbouring forest vegetation,

Table No.11 : Dependence of the local inhabitants on the adjoining forest resources in the study area.

Sr.No.	Forest Resource	Household (%)
1.	Firewood	87.4
2.	Timber	73.2
3.	Timber for Sale	14.6
4.	Gum	2.3
5.	Fruits	54.4
6.	Barks	39.2
7.	Honey	26.7
8.	Honey for Sale	1.0
9.	Wildlife meat	17.5
10.	Wildlife for Sale	0.4
11.	Bamboo	27.1
12.	Bamboo for sale	0.2

Table No. 12 : Type of fuel used by the households in the study area.

Sr.No.	Type of fuel	Household (%)
1.	Wood	99.20
2.	Twigs	00.60
3.	Agricultural waste	00.00
4.	Cow dung	17.90

either from own land or government land. But considering the preference of the people, it is usually collected from the forest land.

Fuelwood extraction is one of the main daily activities in the households from the study area. Every day able bodied persons go out in the search of suitable fuel wood either in the own land or forests areas. The distance travelled to collect the required quantity of wood and the time spent for this activity varies in each household, depending on the fuelwood requirements, distance of source, season, terrain of the area etc.

The distance travelled one way for daily fuelwood requirements in the study area ranged from a minimum of 3.5 km at Shirsinge to a maximum of 7.46 km at Gokul. The mean for the area being 4.64 km. The time taken for the collection of fuelwood requirements was not proportional to the distance travelled as it depended on many variables.

The minimum time recorded for collection of the fuelwood in the study area was 1 hr and 57 minutes in Dicholi village and the maximum time required was 7 hours and 10 minutes in Mirgaon village. The mean time required in the study area was 4 hours (Table No.13).

An attempt was made to evaluate the quantity of fuelwood required per household, daily, monthly and annually (Table No.14). A household of 6 individuals requires around 12,383 kg (S.D. 5,048) of fuel wood with an additional monsoon provision of 8,618 kg (S.D. 2,328). Roughly a total of 21,000 kg fuelwood is

Table No.13 : Mean distance travelled (one way) and time taken (both ways) for collection of daily fuelwood requirements by the households in the each village in the study area.

Sr. No.	Village	Distance km(one way)		T i m e (hr minutes)	
		Mean	S.D.	Mean	S.D.
1.	Nahimbe-Ambeghar	5.18	2.34	3.17	1.00
2.	Shirshinge	3.50	1.41	2.50	1.41
3.	Gojegaon	5.05	1.70	3.24	1.14
4.	Kathi	6.65	1.46	4.00	1.18
5.	Aral	3.66	2.16	3.01	1.02
6.	Kusawade	5.28	1.95	3.21	1.34
7.	Dicholi	4.00	2.03	1.57	0.56
8.	Zadoli	5.00	2.07	3.15	1.03
9.	Zadoli-Ambeghar	6.21	0.75	2.16	1.06
10.	Kisrule-Mura	4.08	2.80	2.16	1.03
11.	Poonoli-Dhokawale	3.77	1.34	2.31	1.43
12.	Poonoli-Kisrule	4.21	2.13	3.04	1.06
13.	Mirgaon	6.48	1.28	7.10	2.19
14.	Kamargaon	6.43	2.05	6.15	3.14
15.	Humbarli (Urban)	6.90	3.05	4.40	1.04
16.	Gokul (Urban)	7.46	1.44	4.27	1.23
17.	Thorne	6.56	2.11	3.32	2.15
18.	Shiwandeshwar	5.32	3.17	5.11	2.28
19.	Ghatmatha	5.71	3.11	5.15	3.21
20.	Mendeghar	5.39	3.36	3.15	1.21
	Mean	4.64	1.69	4.06	1.48

Table No. 14 : Profile of fuelwood requirements of a household and time taken and distance travelled to collect it, mean values from the 20 villages in the KWS.

		Mean	S.D.
1.	Daily requirement (kg)	23.61	13.83
2.	Monthly requirement (kg)	708.35	414.91
3.	Annual requirement (kg)	12,383.24	5,048.16
4.	Add. Monsoon provision (kg)	8,618.27	2,328.77
5.	Distance travelled (one way) household/day (km)	5.57	2.21
6.	Time required household/day (hr)	4.19	2.22

required annually by a household of the study area. This quantity is huge and considering the 980 households in the study area roughly fuelwood consumption amounts to 20,580 Tonn/ year.

The monthly requirements per household was 738.35 kg (414.91 S.D.) this quantum appears to be significant but considering the type of domestic consumption of fuelwood in the study area in general these can be considered as moderate figures. In monsoon months additional fuelwood is required due to the humid and cold climate. Also it is not possible to collect fresh wood due to heavy down pour and fog. This quantity is collected and stored in the premonsoon months in advance.

In addition to the domestic consumption of forest as fuel wood and timber for house construction and agricultural implements.t There are two other major reasons for ever increasing deforestation of the region despite of the area being declared as a wildlife sanctuary. They are clear filling by illicit wood contractors and char coal manufacturers. It is not even possible to roughly quantify the damage caused by these two activities but it is estimated that it must be a huge quantity.

Therefore considering the ever exploited forest resources in the study area, there is a tremendous pressure of deforestation ultimately adversely affecting the animal diversity of the catchment and the wildlife sanctuary.

Each household in the study area had at least two hearths, one for cooking and other for heating water for bathing purpose.

The designs of the hearths were primitive and less efficient as the energy conversion was poor, where as much as 70 % of the heat generated by fuel wood was wasted (Desai et al., 1987).

Due to the cool climate and winds in this high altitude area it takes long time and requires large quantity of fuel wood to heat water. The hearth used for cooking is used twice a day, whereas the one used for heating water is used ones or twice a day depending on the season and working men folks in the family who take bath also in the evening after returning from work. Warm water bath is taken throughout the year by everybody in the household. Also in severe winter and the entire rainy season there is a fire pit burning in each household to maintain the warmth in the hut and in most of the cases it is in operation for 7-8 months. Some other reasons given for using wood in the households is 1. due to the high rainfall in the area wood material in house needs to be replaced every 4-5 years. 2. There is constant attack of termites on wooden material in the house and constant smoke prevents termite attacks etc.

The significant exploitation of forest for fuelwood purpose has its roots in the dam construction. The resettlement of some of the households was done on the slopes in the forested area also the people rehabilitated else where returned and settled in the new areas near forests. Already reduced forests due to dam submergence and the traditional fuelwood consumption practices have kept ever increasing pressure on the forest.

The traditional agricultural practices of shifting cultivation and 'Rab' (burning of foliage for deweeding activity)

also contributes significantly to the destruction of forest biomass in the region. According to the forest experts and wood contractors the mature evergreen and semi-evergreen forests of this region yield around 30-35 Tonns of fuelwood per acre, in the clear felling operations. Therefore the annual utilization of fuelwood of this region alone is equivalant to 235.2 ha of prime forest every year. In the tropics rate of regeneration of vegetation is significant however it will not be possible to match the rate of exploitation and replace the degraded vegetation if the present level and nature of deforestation continues in the study area. This large scale deforestation is causing permanant damage to wildlife diversity in the area.

3.8 Hunting

Due to the poor economic conditions and isolated nature of the settlements the local population was not able to purchase their meat requirement, which was expensive and beyond the reach of most of them. Therefore for the annual protein requirements the local people heavily depend on poaching of wildlife in the neighbouring forests.

Hunting of wildlife for subsistance was a common practice among the locals, mainly Kunabi Dhangar, Harijan and Dhawade (Muslim). In all villages one day in the week is reserved for hunting which differs in every village. This day is known as 'Paliv Diwas' and Tuesday is the day in the east catchment.

Also on festivals like 'Dasara' there is community hunting where everybody participates in the hunt.

Group hunting done by the villagers with the help of traps, local fire arms (muzzel loaders) and 12 bore shot guns issued for crop protection. Trapping is a common practice for which different types of nets supported by stickes are commonly used. Alongwith the local hunters there is a constant influx of outside poachers who are jahagirdars and new rich farmers hunting in the study area for fun and sport. Declaration of the study area as Koyna wildlife Sanctuary has so far made no effect on poaching either by locals or outsiders and animal killings go on unabated. With the destruction of wildlife and deforestation in the areas outside the catchment there has been an increasing pressure of hunting in the study area.

In subsistance hunting the hunters were not specific or particular about the animals to be killed. The local population consumes a wide range of animals including mammals, birds, reptiles and fishes. Even animals like wild dog, bat, giant squirrel, Jackal Fox, Varanus, Ottar are killed and consumed for medicinal purpose. There was indiscriminate killing of animals of both sexes and all ages throughout the season. Outside hunters are organised, more selective and persued larger mammals like sambar, barking deer, wild pig etc.

The kind of animals hunted was dependent on the available hunting gear, man power, type of forest, nature of hunt and of course the availability of wild animals in the region. Table No.9

gives the availability of 30 mammals around the villages in the study area. The present status of animal distribution in the areas around the 20 villages is given in table no. 10. This clearly shows better wildlife diversity in the areas around the settlements in the west catchment as compared to east catchment and the area outside.

Table No.8a gives the past and present status of 31 common mammals from the study area. It is observed that out of the 31 species 16 (51.61 %) still have common status, 3 (9.67 %) have become uncommon from common, 7(22.58 %) have become rare from common, 3 (9.67 %) have become absent from common and the only 2 (6.45 %) species which were uncommon in the past have become rare today.

The commonly hunted animals for wildlife meat for subsistance and game hunting are given in the table no. 15. Altogether 12 animal species were seen hunted in the study area. Out of them the most commonly hunted species are Barking deer, Wild pig, porcupine, pangolin, Hare and Mouse deer. All these animals are killed for meat purpose. Other animals poached are Jungle fowl, Sambar, and Indian giant squirrel, also for meat purpose. Surprisingly wild dog was killed for the medicinal value of its meat. Jackal is killed by a small fraction of people for fur and meat and 'Gaur' was killed by Dhawde community which does not consume wild pig but consumes beef.

It was found difficult to assess the damage caused by subsistance hunting by the locals and outsiders in the study

Table No. 15 : The wild animals hunted and the percentage of households involved in them in the study area.

Sr.No.	Animals	Household (%)
1.	Barking deer	95.23
2.	Wild pig	95.23
3.	Wild dog	61.90
4.	Porcupine	90.47
5.	Jackal	14.28
6.	Pangolin	90.47
7.	Hare	95.23
8.	Mouse deer	90.47
9.	Gaur	4.76
10.	Giant squirrel	66.66
11.	Sambar	71.42
12.	Jungle fowl	71.42

area. As it is illegal and people now know that the area has been declared as a wildlife sanctuary, though without enforcement, collection of any direct information on the secretly performed poaching operations is difficult. However, there was a lot of secondary and indirect evidence which confirmed the scanty information about poaching activities. In general the present uncontrolled poaching practices in the rapidly dwindling forests has created a severe threat to the animal diversity of the region which had already suffered a setback due to the creation of the impoundment.

Perhaps the subsistance hunting at a moderate rate by the local inhabitants could not have affected the animal diversity of the study area. But the cumulative effect of various factors like dam construction, reservoir as a barrier, road facility, use of fire arms by outside poachers, agriculture practices and removal of vegetation has made a drastic and adverse impact on once very rich animal diversity of this region.

3.9 Agriculture

Agriculture is the main occupation of the people in the study area. The local population basically Kunbi Maratha and Dhangar community is involved in traditional agriculture. Though Dhangar community is traditionally a pastoral nomadic community of the Western Ghats, which has switched over to agriculture as the main occupation and animal husbandry as secondary occupation in the recent past. Conventionally the

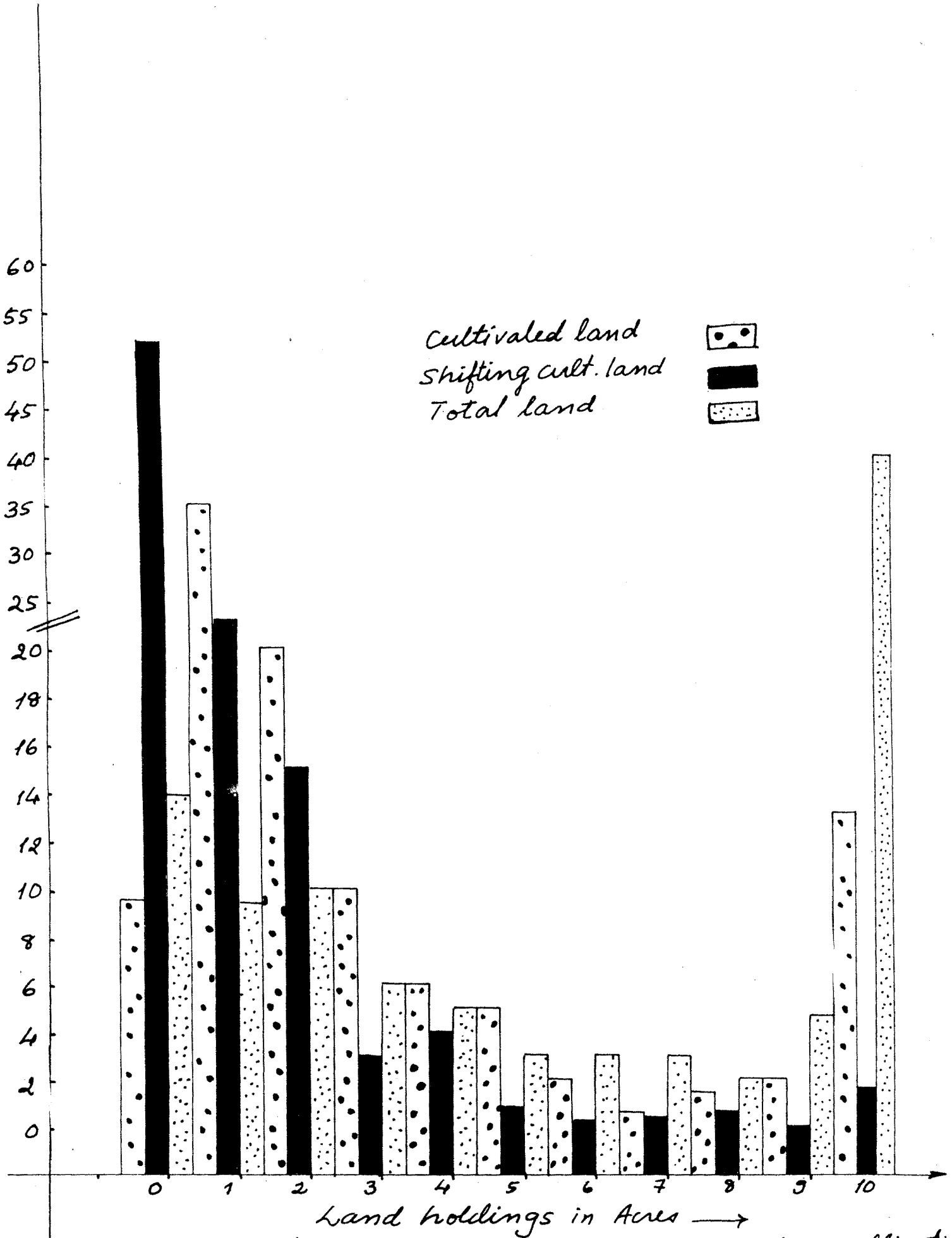

Fig 6: Distribution of cultivated land, Shifting cultivation Land and total land holdings per household in the study area

agriculture practices in the area are of two types 1. Cultivation in the river valley and terraces where paddy is grown on the perennial water supply or rainfed cultivation. 2. Shifting cultivation where hill millets are grown on hill slopes with the help of monsoon rains.

The distribution of land holdings in the area is shown in the table no. 16. A significant percent i.e. 13.9 of the households did not have any land holdings of their own. They mainly cultivated other's land on lease or government land. About 20 % of the households had only 1-2 acres of land. About 28 % of the households had lands from 3-9 acres each and it was almost uniformly distributed. The larger land holdings i.e. 10 acres or more were with almost 39 % of the households. This reveals the fact that the land holding per household in the study area are significantly large.

The traditional cultivation lands, in the valley and on the lower terraces, are absent in case of 9.6 % household. About 50 % of the people had hardly 1-2 acres of this land and only 12.93 % of the households had more than 10 acres of cultivated land. These people were from the east catchment i.e. village Kusawade, Gojegaon Aval and Kathi.

Though shifting cultivation was comparatively a common practice in the region 51.7 % of the households did not have land where they performed this practice. About 37 % of the people had only 1-2 acres of land brought under shifting cultivation every year. About 10 % of the respondents had 3-9

Table No. 16 : Distribution of land holdings per household in the study area.

Sr. No.	Land holdings (acres)	Cultivated land (%)	Shifting Cultivation (%)	Total land (%)
1.	0	9.60	51.7	13.9
2.	1	29.85	22.7	9.4
3.	2	20.45	14.7	10.4
4.	3	9.60	3.1	5.8
5.	4	5.84	4.4	5.2
6.	5	4.80	0.8	2.9
7.	6	2.08	0.2	2.5
8.	7	0.62	0.4	2.9
9.	8	1.46	0.6	3.1
10.	9	2.71	0.0	4.6
11.	10 & above	12.93	1.8	39.0

acres under shifting cultivation and only 1.8 % had more than 10 acres of land under shifting cultivation during the period of investigations (Plate 7 a & b) i.e. villages Zadoli, Zadoli-Ambeghar and Dicholi in the West Catchment.

However, it must be remembered that though people who had no own land under shifting cultivation openly performed the activity in the government land or the fallow land of the people who have been rehabilitated outside the Koyna dam catchment. Similarly many farmers jointly worked on others lands for shifting cultivation. Therefore part of the land belonging to forest or revenue departments and supposingly having forest on it, was actually under shifting cultivation.

According to the respondents some had inadequate own land to grow the minimum required food production. The impoundment of the area also submerged all the fertile paddy lands in river basin which provided labour opportunities to the landless people. These people too have now switched over to shifting cultivation in the adjoining areas. The Koyna catchment has a increasing problem of new setters in the people earlier rehabilitated outside the catchment, who after returning in the catchment selected forested areas suitable for shifting cultivation for first few years and than try to convert them into terracing for regular cultivation. This picture is seen more on the east catchment i.e. Shirsinge, Kusawade etc. (Plate 8).

Shifting cultivation, locally known as 'Kumri' is a traditional 'slash and burn' type of agriculture practice and

is very common on the slopes of the Western Ghats. In this practice the farmers select a patch of mixed forest, preferably 15-20 year old, The vegetation is clear felled and useful timber is extracted but the trash vegetation, branches and foliage is burnt on the spot. At times vast areas of vegetation on steep slopes are set on fire, mainly during the premonsoon months. The shortage of man power to extract timber and fuelwood forces the inhabitants to burn the entire biomass. This is said to increase the soil fertility and destroy weeds. However, this practice is extremely detrimental to the natural flora and fauna. Micro habitats are completely destroyed with all the characteristic biological diversity in it. Along with the trees and bushes hides, nesting sites, food organisms, grasses everything is burnt, this does not leave even the ground fauna. The animals which are not able to save themselves by leaving the area in time get burnt alive.

The exposed land is need for the cultivation of poor quality hill millets namely Nachana and Vari. The poor quality soil does not support any crop after two-three years and it is left fallow for another 4-5 years till the secondary vegetation covers the soil. The shifting cultivation is performed in rotational manner after 4-5 years on the same land. This practice has perhaps evolved in the historic times when the forest resources were plentyful and the cultivated lands needed to expand but the very limited man power could not cultivate the huge forest lands in a traditional way thus shifting cultivation. However, now this practice has become a serious threat to the

environment of the area in general and its biological diversity in particular. The fire causes permanant damage to the flora and fauna of the region changing the vary composition of the animal diversity which in turn drastically reduces the survival chances of the animal populations in the fragmented forests.

It was observed in certain areas around the villages of Taloshi and Karanjawade, which people left after dam construction, there has been excellent growth of forest due to the successional stages and the forest regeneration has brought back near natural conditions and animal diversity where once extensive shifting cultivation was performed.

The traditional crops grown in the study area are paddy in the low lying areas and flat lands and Nachana, Vari, Rai, Til on the steep hill slopes. The poor quality soil and lack of water facility, during summer months, on the hill slopes had prevented introduction of exotic crops in the region. But after the dam construction with the help of new roads and better communication facility about seven crops are grown in the study area (Table No.17). Wheat being the dominant (47.11 %) exotic crop of the region followed by Maize (39.96 %). Others not so prominant, crops are Jawar (2 %), Gram (3 %), Groundnut (3.7 %), Sugarcane (2.58 %) and vegetables (1.59 %).

Sugarcane has been restricted to only very small areas in villages, Gokul & Kusawade. This crop has known to disturb the agriculture pattern drastically in other areas of the Western Ghats of Maharashtra (Surwase, 1988). Being an important cash-

Table No.17 : Percentage of other crops grown in the study area.

Sr.No.	Crop	%
1.	Maize	39.96
2.	Jawar	2.06
3.	Wheat	47.11
4.	Gram	2.98
5.	Groundnut	3.77
6.	Sugarcane	2.58
7.	Vegetables	1.59

crop farmers are tempted to grow it even if it requires huge quantity of irrigation, good soil with depth, manure and fertilizers and good transport facility to reach it to the sugar factory immediately after its harvest. Presently these conditions are not available in the study area. On the other hand non feasibility of sugarcane cultivation in the study area has indirectly saved the natural vegetation from wanton destruction for more land and also the huge quantity of fuelwood to manufacture jaggary and sugarcane.

Wherever water is available from alternate water source wheat is cultivated in the study area as a non traditional crop followed by maize which is grown on the surplus water available.

The croping pattern in the study area is dependent on two factors namely availability of water and crop pest. For some villages spring water supply is available for most of the year but for others the water supply is in the valley and the fields are high up on the slopes or hill tops for them irrigation is the real problem. Interestingly the villages on the bank of the Shivaji Sagar reservoir are not allowed to lift the water from the reservoir for irrigation purpose. The poor socio-economic conditions of the villagers unable them to go in for non-traditional crops and investments in electric pumps. In many villages there is no electricity and also road facility to carry their harvest to the nearest market place.

The existing agriculture practices like shifting cultivation and 'Rab' in traditional cultivation have been proved to be

detrimental to the biological diversity of the region. The present agriculture of the area is not economically viable considering huge intangible environmental losses encurred to support the existing poor returns and land use practices. The only suitable alternative appears to be totally shifting to horticulture and social forestry from the conventional shifting cultivation in the rapidly degrading Koyna Catchment and Wildlife Sanctuary area.

3.10 Agriculture Pest

Man and wild animal interaction is at its maximum when it has direct competition for food and space as it is revealed in the case of agriculture pest in the study area. This interaction depends on several complex variables like proximity to the natural habitat of the pest species, nature and extent of cultivation, quality of adjoining forest habitat, animal density and diversity in the area, carrying capacity of the forests, climatic and crop harvest seasons, crop protection measures etc.

During the present investigations attempts were made to study the major agriculture pest problems by considering ten major agriculture pests of the study area.

It was revealed that all the villages had severe crop pest problem of varying nature. All the villages from the west catchment, surrounded by good quality forest vegetation were visited by all the 10 major crop pests studied (Table No. 18). Contrasts to this, as expected, in the villages from east

Table No.18 : Present status of mammalian pest on agriculture in each village in the study area.

Sr.No.	Villages	%
1.	Nahimbe-Ambeghar	72.72
2.	Shirshinge	63.63
3.	Gojegaon	63.63
4.	Kathi	63.63
5.	Aral	72.72
6.	Kusawade	72.72
7.	Dicholi	100.00
8.	Zadoli	100.00
9.	Zadoli-Ambeghar	100.00
10.	Kisrule-Mura	100.00
11.	Punooli-Dhokawale	100.00
12.	Punooli-Kisrule	100.00
13.	Mirgaon	90.90
14.	Kamargaon	90.90
15.	Humbarli (Urban)	90.90
16.	Gokul (Urban)	90.90
17.	Thorne	100.00
18.	Shivandeshwar	100.00
19.	Ghatmatha	90.90
20.	Mendeghar	72.72

catchment the intensity of crop pest was the least in the study area. This is attributed to poor general animal diversity, including crop pest, of the region. The 6 villages outside the Koyna catchment but from the Koyna Wildlife Sanctuary had mixed but more than east catchment crop pest incidence. Though Humbarli and Gokul are now considered as urban area, crop pest problems are still common in them. Villages Torne and Shivandeshwar being amidst thick vegetation are visited by all the major crop pest (Plate 9).

The picture of the past and present status of crop pest in the study area shows that wildboar Sus scrofa (92 %) is the most dominant crop pest, followed by porcupine (70.3 %). Other pests of significance are Gaur (18.9 %), Hare (28.8 %) and both the primates of the study area Hanuman Langur and Bonnet monkey (18.9 %) (Table No. 19).

The change in the past and present status of the 10 species studied reveals that three animals namely Sambar, Barking deer and Jackal, recorded reduction in their incidence. Though in case of Sambar it was insignificant. The reduction in Barking deer (-64.8 %) and Jackal (-27.1 %) is significant over the past status. The reason for the drop in the pest incidence of these three species is perhaps related to their large scale poaching by local inhabitants for meat purpose.

The increase in wild boar (+ 4.4 %) raids on crops are due to four main features 1. Increase in agriculture around forests 2. Deforestation and the destruction of natural habitat,

Table No.19 : Change in the status of crop pest in the study area.

Sr. No.	Crop pest	Status		Change
		Past	Present	
1.	Wild boar	87.6	92.0	+ 4.4
2.	Gaur	10.6	18.9	+ 8.3
3.	Sambar	7.0	6.6	- 0.4
4.	Porcupine	2.0	70.3	+ 68.3
5.	Barking deer	66.4	1.6	- 64.8
6.	Jackal	27.7	0.6	- 27.1
7.	Hare	3.3	28.8	+ 25.5
8.	Field rats	0.6	2.3	+ 1.7
9.	Bonnet monkey	-	18.9	+ 18.9
10.	Langur			

3. Introduction of exotic crops and dispersal of wildboar and
4. Lack of natural predators.

Gaur, Bos gaurs was never the main crop pest, particularly in the east catchment. But in the west catchment around the villages Ghatmatha to Navja it has increased its raids on crop (+ 8.3 %). The reasons for the phenomenal increase in porcupine (+68.3 %) attacks on crops are attributed to their increased population in the east catchment. The recent degradation of the area and lack of any natural predator provides an excellent habitat for this species which is again attracted to the exotic crops. Similarly the increase in the Blacknaped Hare population (+ 25.5 %) was reported in the same area due to reasons given above.

The primate raids on fruit bearing trees were reported increased around the villages in the east catchment and outside the catchment villages. The increase of (+ 18.9 %) was attributed to the loss of natural arboral habitat due to clear felling, agriculture expansion and shifting cultivation. Therefore now the primate troops belonging to both the species were found in the fragmented patches of vegetation around villages. Also due to the clear fellings the primates have lost their local migratory corridors to other degraded habitats and have become residents thus increasing the frequency of their raids on variety of crops in different seasons. Lack of their natural predation by the dwindling number of tigers and panthers is also responsible for increase in the primate raids on crops.

In general the increase in crop pest incidence is attributed to a host of factors. The important being the destruction of natural habitat of the mammalian pest species in the adjoining areas, expansion of agriculture and replacement of earlier forest habitat by cultivable waste lands, drastic reduction in the carnivore population and may be as mentioned by the fraction of respondents, increase in the number of wild animals and the non traditional crops attracting the animals from the neighbouring forests.

The increase in crop raids is a result of the cumulative effect of one or more of the factors at one given time, though in different situations the dominant or causative factors are different.

Crop protection is a main activity during the preharvest season, of the residents of the study area. A common complain made by the respondents about the problem that now agriculture has become more difficult and labourous and not cost effective as before due to the crop protection efforts. It can be understood why the local people have strong feelings against wild animals. This attitude may pose some problems in the effective management of the Koyna Wildlife Sanctuary.

Crop protection measures require different approaches because of the diverse nature of problems depending on the pest species involved, season, available man power, resources and materials, type of crop to be protected etc. Survase (1988), Ahamad (1988) and Samant et al. (1988) have discussed various

crop protection measures taken by the local people in the Western Ghats.

The study of the ten crop protection measures taken by the local farmers to gaurd their crops revealed that Noise (94.57 %) was the main measure followed by Stone Throwing (74.94%) Fire (69.93), Scare crow (47.18 %), Fivearms (13.56 %) and Crackers (1.04 %) other measures like electricity and fence, were just insignificant. Trenches and crude bombs are not used the study area.

The most commonly used method is of making loud noise either vocal or by beating empty tins. The people camp at night in the fields and give loud calls at intervals. This measure though cheap is very laboureous and is continued till harvest season. Though this method is not very effective, some respondents felt that the animals get used to it after some time, but it is the most common practice. If no person is available to gaurd the field or in rains and on windy days a mobile made of empty tins and sticks is over hanged to trees which makes noise in different frequencies with wind. This is said to discourage crop pest from approaching crops.

Most of the crop pests being nocturnal in habit fire is extensively used to scare them away, also the fire provides wormth to the person on gaurd. Because ample fuelwood is available around, this method is quite common and also effective to certain extent. The only disadvantage is during rains to keep it burning.

Table No.20 : Crop protection measures taken in the catchment area.

Sr.No.	Protection measures	%
1.	Noise	94.57
2.	Fire	69.93
3.	Firearms	13.56
4.	Crakers	1.04
5.	Electricity	0.20
6.	Scare crow	47.18
7.	Stone throwing	74.94
8.	Fence	0.20
9.	Trenches	0.00
10.	Crude Bombs	0.00

Stone throwing (74.94 %) and Scare crow (47.18 %) are other twoeffective and commonly used crop protection measures. These methods are more effective during day light. Scare crows made of a variety of materials i.e. hey, old garments, sticks, pots and white cloth and colour is a simple and inexpensive method in the un gaur,ed or unmanned fields in the remote areas. This is found effective against bird pests also. Stone throwing is a measure used at day and night, but it is more effective at day time because stones can be thrown in the direction of the approaching pests like birds and animals to scare them away if not to kill them.

Firearms are reportedly used on a limited scale (13.56 %) to protect crops from the larger mammals. It is not only an effective measure but if not used properly could prove detrimental to wildlife as it often does in the study area. Really speaking use of fire arms for crop protection is a common practice throughout the Western Ghats of Maharashtra. During the "Grow More Food Campaign" and "Green Revolution" time freely crop protection liscences were issued to farmers. A large number of farmers already had primitive muzzle loader guns, and country made guns, which were illicitly used for poaching. There is no information about the number of firearms in the study area. Also because many people refill the used cartridges. It is difficult to know how many have been used during crop protection and for poaching.

The firearms instead of using in the fields for crop protection are normally used away from the fields but in the

forested areas for killing animals for meat. Also there are constant visits of sport hunters from outside who take help of local guides and under the pretex of controlling pest animals kill most of the animals they come across. And instead of killing wild boar, the commonest pest of the region, Sambar, Barking deer, Mouse deer, Porcupine, Squirrel, Pangolin and even Carnivora are killed for sport purpose. Since the guide and the local people get share of the hunt, do not report the incidence. Therefore indirectly this kind of crop protection measures by locals as wel as outsiders are causing great damage to the animal diversity of the region.

3.11 Animal Husbandry

The changing environmental conditions and land use patterns are also reflected in the animal husbandry practices in the study area. If we consider this traditional pastoral practice of the region, which once was well known, it would perhaps be possible to trace the indirect impact of changed environment due to dam construction and agriculture practices on the animal diversity of the region through animal husbandry. The domestic animal population of any wildlife reserve is an indication of the state of wildlife in it. Because the domestic animals compete for food water and space with the wild herbivores. Therefore the over population of domestic animals and their distribution in the area often proves detrimental to wildlife.

The study area being part of the proposed Koyna Wildlife

Sanctuary it becomes important to study the animal husbandry in the region. During the present investigations attempts were made to study this aspect. At the time of investigations there were 1899 buffalo, 7897 cattle and 2248 goats in the study area. The domestic animal population was dominated by the dwarf 'Dangi' cattle (65.57 %) followed by goats (18.67 %) and buffalo (15.76 %). The buffalo and cattle are used for milk and agriculture labour purpose and goats for milk and meat.

The Western Ghats were once dominated by the pastoral community of Gaoli Dhangar of this region, who maintained large herds of buffalos (Gadgil & Malhotra, 1979). It was observed during the investigations that this picture is gradually being changed with the changing environmental conditions of the study area. Buffalo being endemic to tropical climatic conditions requires large quantity of green fodder and plenty of water, naturally the areas which no longer provide these basic requirements have decline in buffalo populations.

Pattern of buffalo and cattle holdings per household is given in the Table No. 22 & Fig. 7. Almost 54 % of the households had buffalo, 22 % had 1-2 buffalo and about 20.7 % households had buffalo population ranging from 3-9 animals and only 3.9 % households had 10 or more animals at home. This last category was of Dhangar community who still keeps larger herds for milk purpose.

The pattern of households having cattle was different than the one mentioned above, Table No. 22, only 15 % households

Table No. 21 : Major domestic animals, their number and percentage in the study area.

Sr. No.	Animals	Number	Percentage
1.	Baffaloes	1899	15.76
2.	Cattle	7897	65.57
3.	Goats	2248	18.67
	Total	12044	100

Table No.22 : Percentage of households having buffelos and cattle in the study area.

No.of Animals per household	Buffelos	Cattle
0	53.6	15.0
1	11.3	5.2
2	10.6	9.6
3	4.6	6.9
4	7.9	10.6
5	2.7	7.1
6	1.8	6.5
7	1.5	4.6
8	1.0	3.3
9	1.2	4.2
10	3.9	26.9

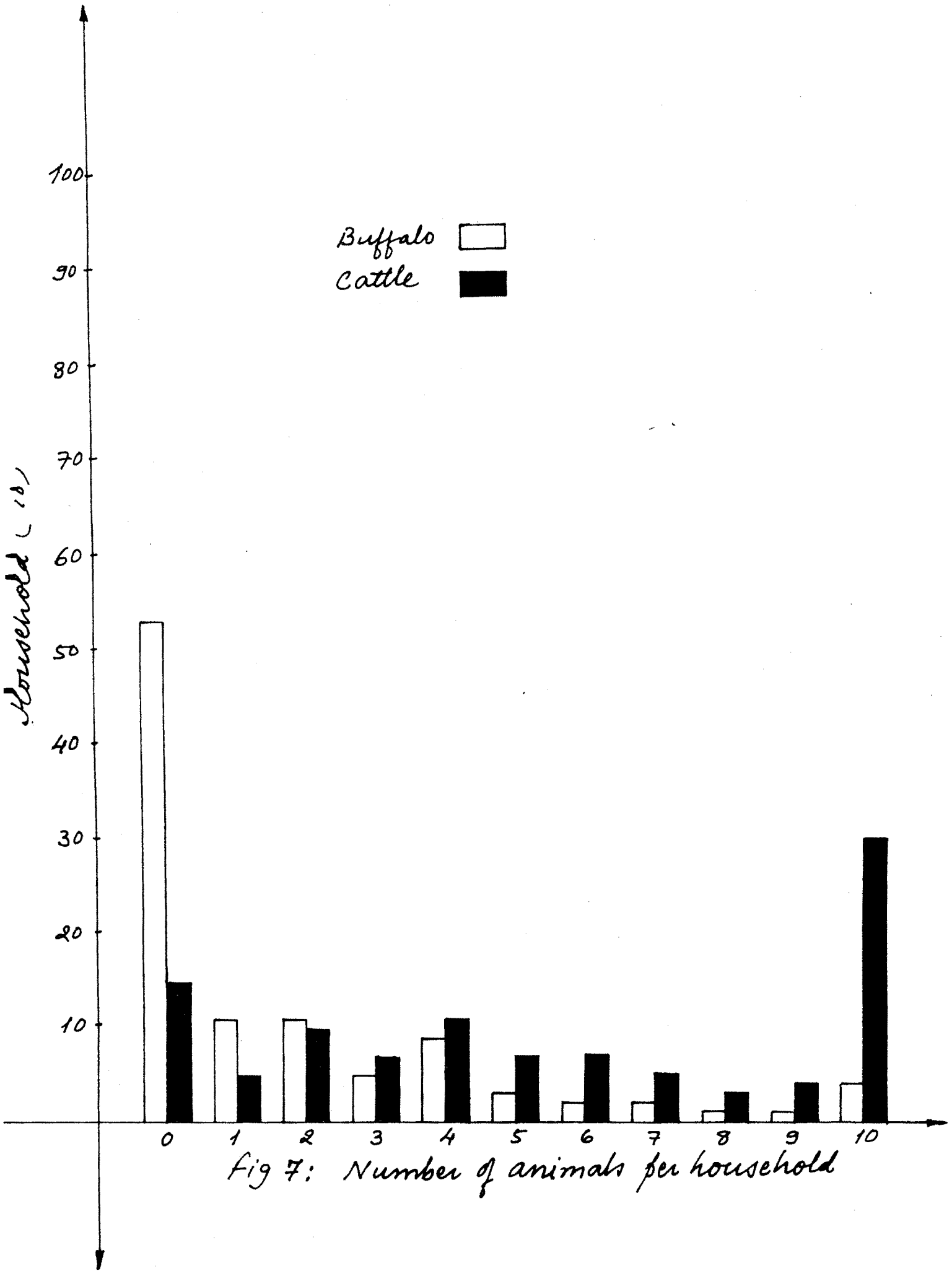

Fig 7: Number of animals per household

had no cattle, about 15 % had 1-2 cattle, 24.6 % households had 3-5 cattle, 18 % with 6-9 and a large proportion of households i.e. 26.9 % had 10 or more cattle.

It means that only 46.4 % of the households had buffaloes while cattle were owned by almost 85 % households (Plate 10a & B). In many households both the animals were present which were basically maintained for subsistance. If the animal size was more it was as a secondary occupation with agriculture as the main occupation. Only the households with sound economic conditions could maintain large number of milching animals. Dhangar households with larger animal herds had animal husbandry as the main occupation and inspite of the large heards, due to the lack of agricultural lands to support their livelihood there economic conditions were not very sound. Also in case of large cattle heards the number of individuals in the households was a contributing factor, wherever only 1-4 animals were maintained they were normally bulls or male buffaloes for agricultural use.

The changing ecological pattern is evident from the recent introduction of goats in the study area. Goats are basically animals of less rainfall area who prefer scrub and bush to evergreen vegetation. It was learnt from the respondents that few decades ago there were no goats in the study area but now they are not only introduced but have adjusted to the changing habitat and are found suitable to maintain. Perhaps this is a direct indication of the environmental change in the region. There also appears to be a direct correlation between the

degradation of evergreen vegetation and increase in the number of goats (Plate 11 a & b).

The table no. 23 gives the distribution of goats in the study area about 34.7 % of the households had goats out of which 1-5 goats were owned by 9.6 %, 6-10 (6.6 %), 11-15 (2.08 %), 16-20 (2.08 %), 21-40 (2.29 %) and 41-60 (0.20 %), households respectively. Figure 8 graphically presents the relationship of number of goats and household percentage in the study area.

As in case of any wildlife sanctuary the domestic animals from Koyna Wildlife Sanctuary interact strongly with the wild-herbivores for food, water, space and also to avoid predation by the carnivores. This conflict is inevitable because most of the time same habitat is being used. This has certain impact on wildlife diversity of the region, because human involvement in controlling the potential predator population of the area by killing them and encouraging the livestock by offering protection and to use more natural habitats is bound to have an impact on the carrying capacity of the herbivores of the area.

Grazing practice of the region is much simpler and traditional where whole day animals are allowed to graze freely in the areas with good fodder and water supply. Normally the animals are taken to nearby forest. Table No. 24 gives an idea about the source of leaf fodder used by the livestock from the study area. Fig.9 presents the same values in Pie chart. The maximum i.e. 44.5 % of green leaf fodder is used from the forests, followed by the village community land or Gaothan(12.9%),

Table No.23 : Percentage of households having goats in the study area.

No. of Goats	Household (%)
0	77.03
1 - 5	9.60
6 - 10	6.68
11 - 15	2.08
16 - 20	2.08
21 - 40	2.29
41 - 60	0.20

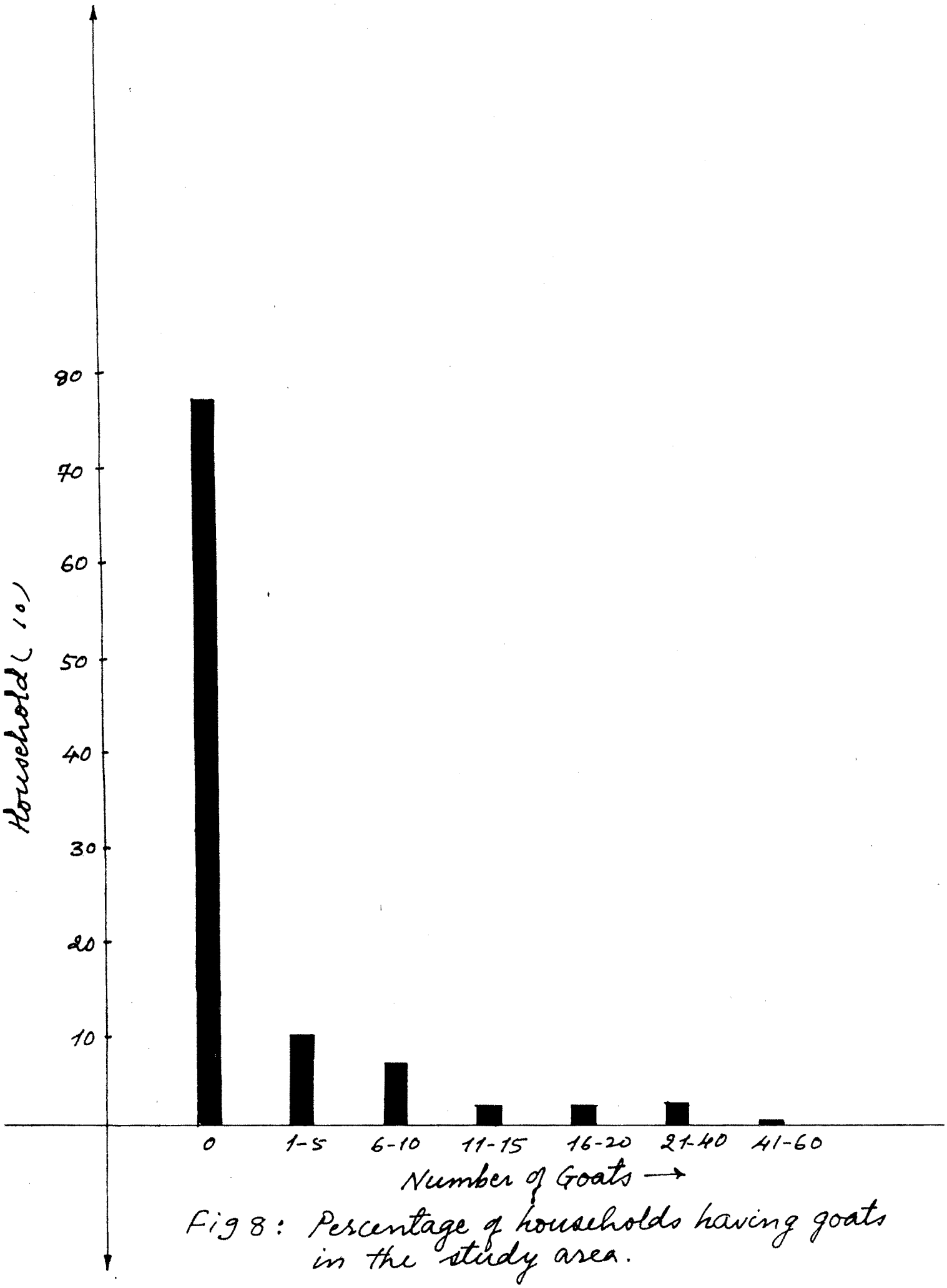

Fig 8: Percentage of households having goats in the study area.

Table No. 24 : Source of leaf fodder in the study area.

Sr.No.	Source	%
1.	Gavthan (Community land)	12.9
2.	Devrai (Sacred Grove)	-
3.	Forest	44.5
4.	Own land	6.05
5.	Not applicable	36.5

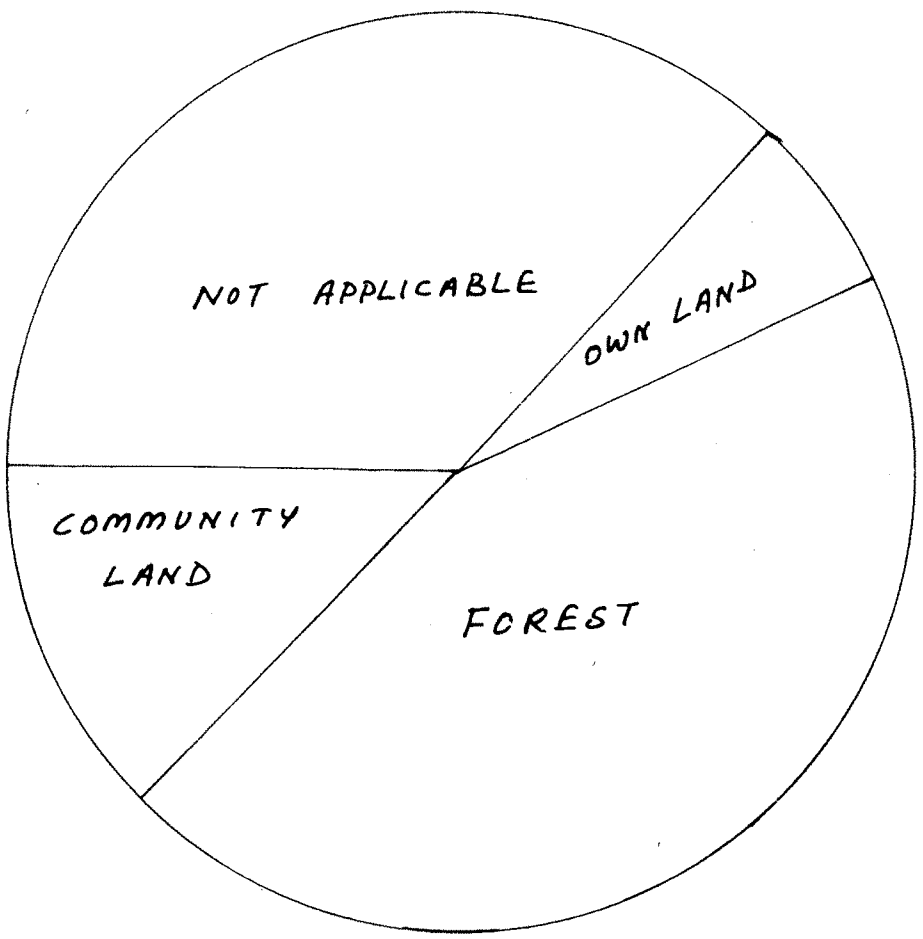

Fig 9: Source of leaf fodder in the study area.

very little leaf fodder is exploited from the own land (6.05 %) as expected. Due to the religious belief and availability of leaf fodder elsewhere, it is not collected from the sacred Grove or Deorai of the area. A significant proportion i.e. 36.5 % people do not use leaf fodder at all. However 63.5 % of the households who use leaf fodder are likely to disturb the arboral fauna while collecting the fodder.

The 20.87 % of the people had no livestock, or had only bulls which were fed on supplementary diet. Out of the people who had livestock mainly used forest land and waste land in the region rather than using own land (Table No.25). Just an insignificant fraction (0.62 %) used only own land for grazing the livestock. Rest of the people used either own land + waste-land (17.95 %), wasteland + forest (16.07 %) or own land + waste-land + forest (30.06 %) (Fig.10). Normally waste lands, old shifting cultivation lands, with scrub area degraded vegetation offered better grazing grounds. These areas had large grass patches and stunted vegetation easy to reach for animals. Also there was less danger of predation from these parts of degraded forest (Plate 12 a & b).

Distance travelled for grazing is obviously dependent on the availability of fodder, water time spent for grazing, season, topography of the region etc. In the study area the largest percent of people (32.9) travel 7-8 km one way for grazing their animals daily. Though the distance covered one way ranges from 1-2 km (1.6 %) to 11 km and above (6.2 %). The distance travelled by animals for grazing is graphically presented in

Table No. 25 : Household percentage using different types of land for grazing.

Sr.No.	Land type	Household (%)
1.	Own land	0.62
2.	Waste land	3.34
3.	Forest	4.59
4.	Own + Waste land	17.95
5.	Own + Forest land	6.47
6.	Waste + forest	16.07
7.	Own + Waste + forest	30.06
8.	Not applicable	20.87

1. Own land
2. Waste land
3. Forest
4. Own + waste land
5. Own + forest land
6. Waste + forest
7. Own + waste + forest
8. Not applicable

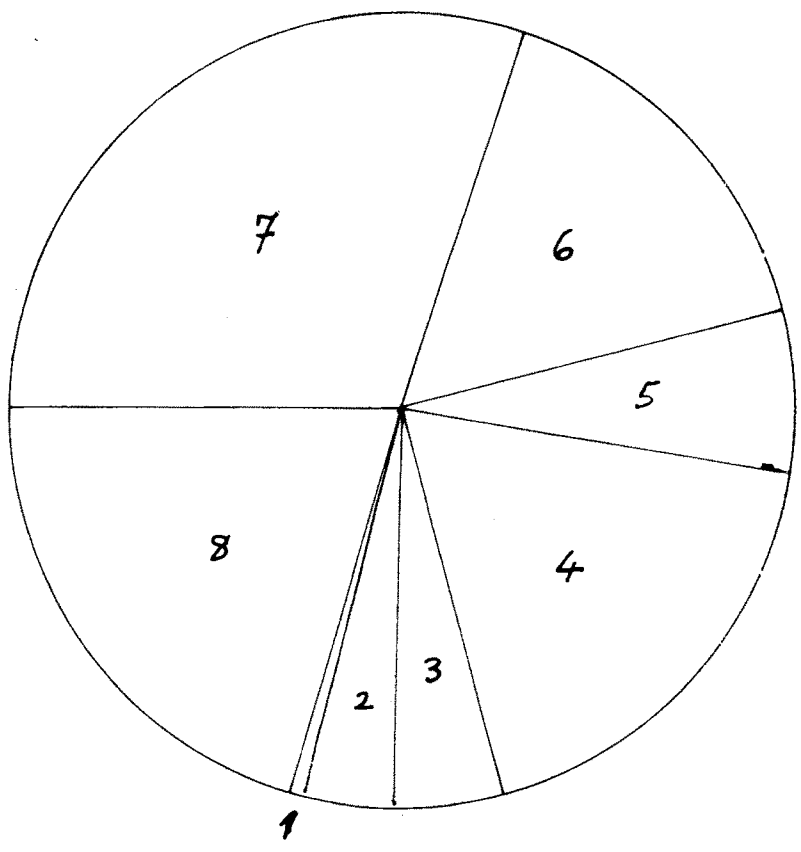

Fig 10: Use of different types of lands for grazing in the study area.

figure 11. It clearly shows that in maximum percentage of households (60 %) the animals travel from 5-10 km every day one way for grazing purpose (Table No.26).

Time spent for grazing is also dependent on availability of fodder, type of fodder, distance travelled for grazing, topography of the region, season etc. wherever the source of fodder is close by the animals spend less time for reaching the place. Table No. 27, reveals the interestic picture of time spenting by the animals. In most of the cases i.e. (38 %) of households animals took more than 10 hours/day for grazing. This is mainly because of the free grazing in the jungle or scrub area where animals are often scattered in all possible directions deep in the forests and other natural habitats. Figure 12 gives a graphical presentation of the time taken for grazing in the study area.

As a normal grazing practice the animals are let loose in the morning from their stalls and go freely in the routine grazing area. They are scattered while grazing and return home before dark in the evening. While in the forest they get sufficient time to come in contact with the flora of the region and if they are already affected by disease spread the epidemic of Rinderpest and foot and mouth disease to sensitive wild animals. This has happened on many occassions in the past in number of wildlife sanctuaries and national parks in the country.

It is not only the households with animal holdings give an indication of the conditions in the village and around but

Table No.26 : Distance travelled by domestic animals per day (one way) for grazing in the study area.

Sr.No.	Distance (km)	Household (%)
1.	0	18.2
2.	1 - 2	1.6
3.	3 - 4	13.3
4.	5 - 6	18.1
5.	7 - 8	32.9
6.	9 - 10	9.3
7.	11 and above	6.2

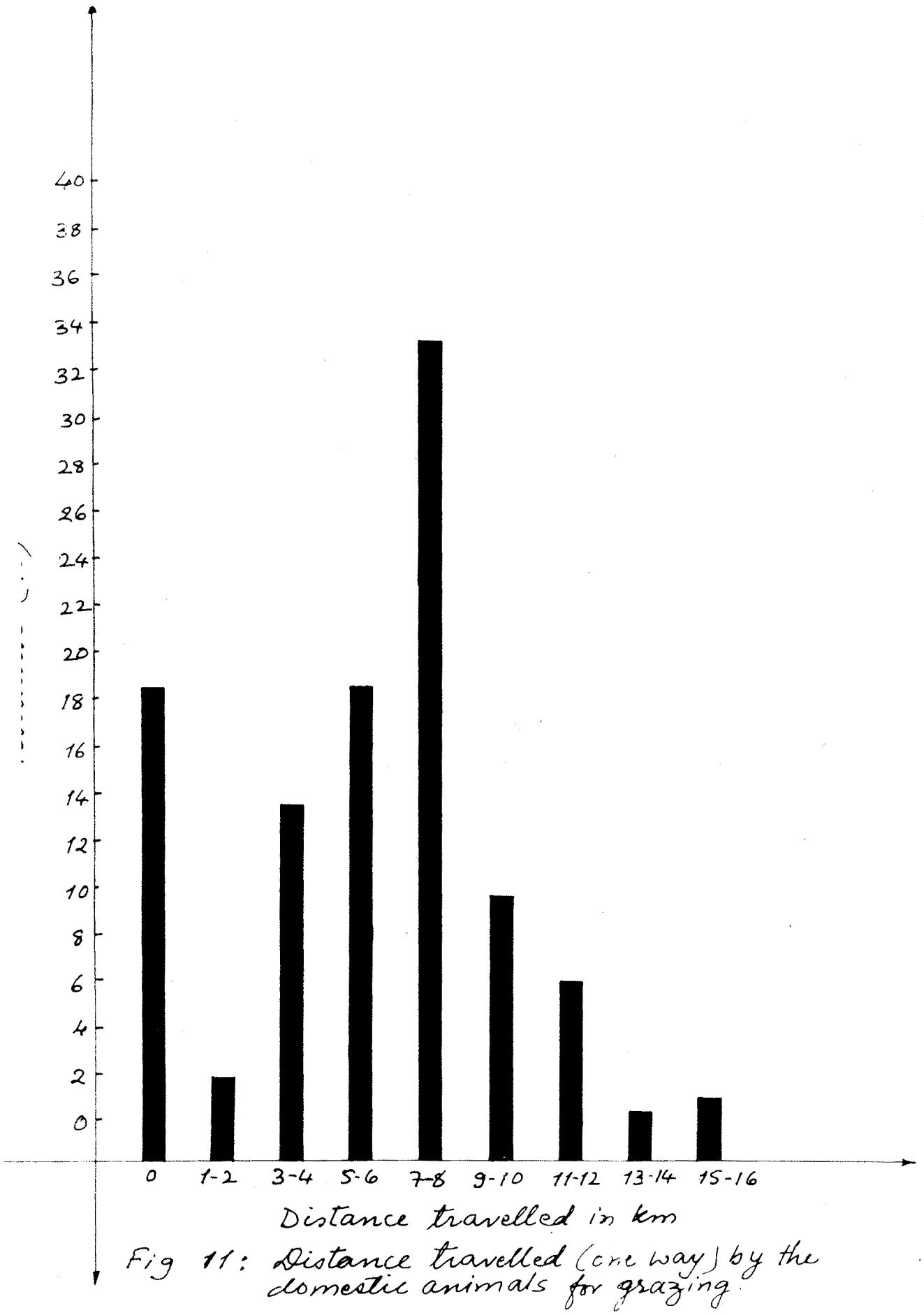

Fig 11: Distance travelled (one way) by the domestic animals for grazing.

Table No. 27 : Time spent per day for grazing by domestic animals.

Sr.No.	Time (hrs/day)	Household (%)
1.	0	17.3
2.	1 - 2	0.8
3.	3 - 4	1.7
4.	5 - 6	6.3
5.	7 - 8	9.2
6.	9 - 10	6.3
7.	above 10	58.0

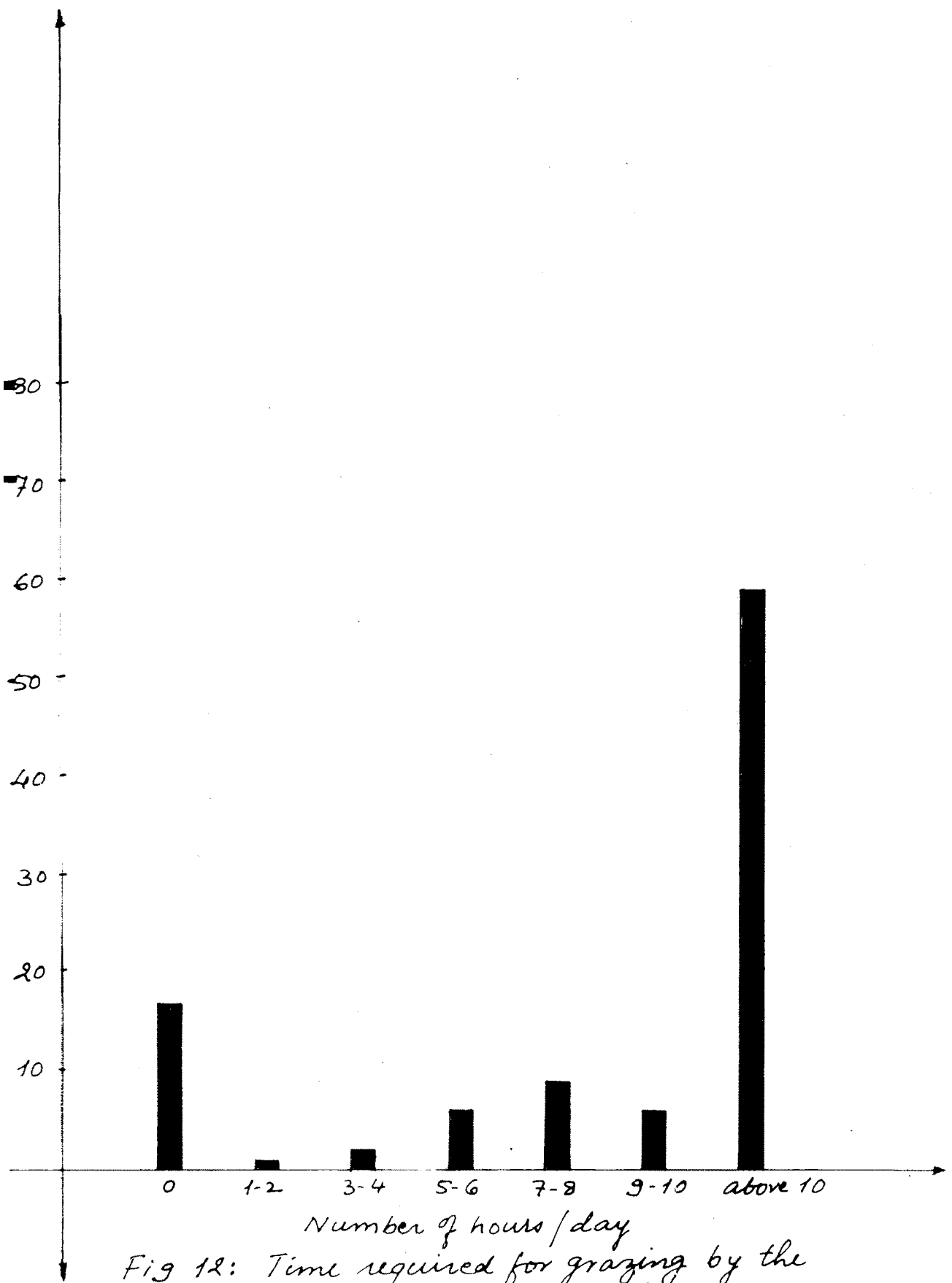

Fig 12: Time required for grazing by the domestic animals per day.

even the percentage of households without any animal holdings. Table No. 28 gives the general profile of the villages from different catchment having households without animal holdings. In the east catchment there were very few household without animal holdings except in Kusawade, where due to better agriculture prospects 10 % of the households from the study area are found without animal holdings. In the west catchment in villages Zadoli, Zadoli-Ambeghar, Kisrule-Mura and Poonali-Kisrule every household had animal holdings this is perhaps due to some excellent vegetation still intact around the villages. In the villages Mirgaon (18.57 %) and Kamargaon (30 %) the neighbouring forests have been brought under cultivation therefore there are no suitable grazing grounds. Also people from Mirgaon, Kamargaon, Gokul are employed on the Koyna dam project and they have income from other sources as wel.

The dam impoundment submerged low lying grasslands and wastelands which were mainly used by domestic animals and grass patches in the forest were left undisturbed and were used by wild herbivore populations which supported significant predator diversity and density. After the submergence of the original pastures the domestic animals have invaded forests thus directly inter acting with wild animals. Therefore this apparantly harmless age old practice of animal husbandry is causing direct impact on the forest ecosystem by over exploiting the essential natural resource from wildlife i.e. the fodder water, shelter etc. The human activity has also increased in

Table No.28 : Percentage of households without domestic animals holdings in the villages from East and West and outside the Koyna Catchment.

Sr.No.	Name of the village	Location	Household(%)
1.	Nahimbe - Ambeghar	east	1.42
2.	Shirshinge	east	1.42
3.	Gojegaon	east	1.42
4.	Kathi	east	4.28
5.	Aral	east	0.00
6.	Kusawade	east	10.00
7.	Dicholi	west	2.84
8.	Zadoli	west	0.00
9.	Zadoli-Ambeghar	west	0.00
10.	Kisrule-Mura	west	0.00
11.	Poonoli-Dhokawale	west	1.42
12.	Poonoli-Kisrule	west	0.00
13.	Mirgaon	west	18.57
14.	Kamargaon	west	30.00
15.	Humbarli	west	1.42
16.	Gokul	Outside	7.10
17.	Torne	Outside	2.84
18.	Ghatmatha	Outside	4.28
19.	Shiwandeshwar	Outside	4.28
20.	Mendeghar	Outside	8.56

Table No. 29 : Change in the frequency of predation of domestic animals by five predators in the study area.

Sr. No.	Animals	Frequency %		Change
		Past	Present	
1.	Tiger	71.3	31.5	- 39.8
2.	Panther	53.8	27.5	- 26.3
3.	Wild dogs	61.6	42.7	- 18.9
4.	Jackal	55.7	43.6	- 12.1
5.	Bear	18.4	14.2	- 4.2

the forest along with the grazing cattles and now man has direct conflict with the predators of the region; whenever a chance is available they are killed indiscriminately in order to protect the domestic animals from them.

All the five species of predators considered to be dangerous to the livestock the local people are now on the decline (Table No.29). The past and present status of these predator's shows that the largest predator tiger (-39.8) is the most affected followed by Panther (-26.3), Wild dogs (-18.9), Jackal (-12.1) and Bear (-4.2). This reduction is more by hunting and loss of prey species than habitat distruction. This human activity has long lasting and perhaps irreversible effects on the animal diversity of the study area.

3.12 Water Resource

Water is an important natural resource for wild animals and human alike. In the Western Ghats, due to the heavy annual precipitation, streams and springs are known to be perennial and shortage in water resources is not anticipated.

The man induced changes in the environment are partially responsible for alterations in water quality, quantity and duration of flow in the study area. Apparently there is no direct relation between changes in the water resource due to human utilization and wild animal diversity of the region. However, it was felt that the knowledge about the changes was useful as an indication of the degradation of nature in general. Therefore

use of water by local inhabitants was studied in detail. In the hilly high rainfall area the main water source for the remote scattered settlements was springs and streams. From the time immemorable these sources have been perennial wherever their origin is in the thickly vegetated hills.

Though there is a huge quantity of water stored in the Shivaji Sagar Reservoir of the Koyna Hydel Project the villages in the hilly catchment area do not get any benefit and they have to depend on rains, spring, well, tubewell etc. in order to meet their domestic water requirements. Even for the agricultural purpose the residents of the dam catchment area are not allowed to use the reservoir water.

During the rainy season there is plenty of water available in this high rainfall area but after late winter scarcity water is felt in some villages. When the 6 sources were studied for the supply of water during rainy season, winter and summer (Table No.30), it was found that almost 76.61 % of people depend on spring water during all the three seasons. This is followed by the tubewells (9.81) mainly from Kamargaon from east catchment. Other sources of water were just insignificant i.e. Well (1.25 %), River (3.13 %), Dam (0.2 %) and Waterhole (0.4 %).

Almost all the respondents were collecting water from the perennial springs in hills., this water was also used for domestic animal and agriculture. It is needless to say that some of these springs may have been frequented by the wildlife

Table No.30 : Number of households from the study area using different sources of water in Summer, Rainy and Winter Season.

Sr. No.	Season	Well	Tubewell	Spring	River	Dam	Water hole
1.	Rainy	0	0	1	0	0	0
2.	Winter	0	0	0	0	0	0
3.	Summer	0	0	3	4	1	2
4.	Rainy & Summer	0	11	10	0	0	0
5.	Rainy & Winter	1	0	0	0	0	0
6.	Winter & Summer	0	0	0	5	0	0
7.	Rainy, Winter, Summer	5	36	353	6	0	0
	Total	6	47	367	15	1	2
	%	1.25	9.81	76.61	3.13	0.20	0.41

in the region. Therefore these open springs play an important role in the water supply to wildlife and should not be used for the closed water supply by PVC pipes by gravitation to the villages on slopes and in the valley as in case of some of the other wildlife sanctuaries in the south Maharashtra (Samant et al., 1988).

The water quantity requirements of each household was different and it depended upon number of factors mainly individuals in the household, distance to be covered to collect the required quantity, season etc. The daily requirement of a household of 6 individuals in the study area varied from 1-40 liters to 800 liters and above, (Table No. 31).

It was observed that the largest proportion of households (33.40 %) required 121-200 lit of water per day followed by 201-300 lit/day (19.62 %) and 301-400 lit/day (16.91 %) about 2.08 % households required more than 800 lit/day. These were basically large families and also some quantity of water was for domestic animals. Figure 13 gives good graphic presentation of the percentage of households using different quantities of water per day.

Since in most of the villages the water source was much closer therefore the distance travelled to fetch the daily water requirements was not much. About 37.90 % people had to walk only 50 meters (one way) to collect their daily quota of water. The table no. 32, gives the range of distance travelled by the people in different villages. The distance to be

Table No. 31 : The percentage of households using different quantities of water per day.

Sr.No.	Water in liters	Households (%)
1.	0	1.67
2.	1 - 40	0.83
3.	41 - 80	4.59
4.	81 - 120	8.76
5.	121 - 200	33.40
6.	201 - 300	19.62
7.	301 - 400	16.91
8.	401 - 500	5.21
9.	501 - 600	3.75
10.	601 - 700	0.41
11.	701 - 800	2.71
12.	800 and above	2.08

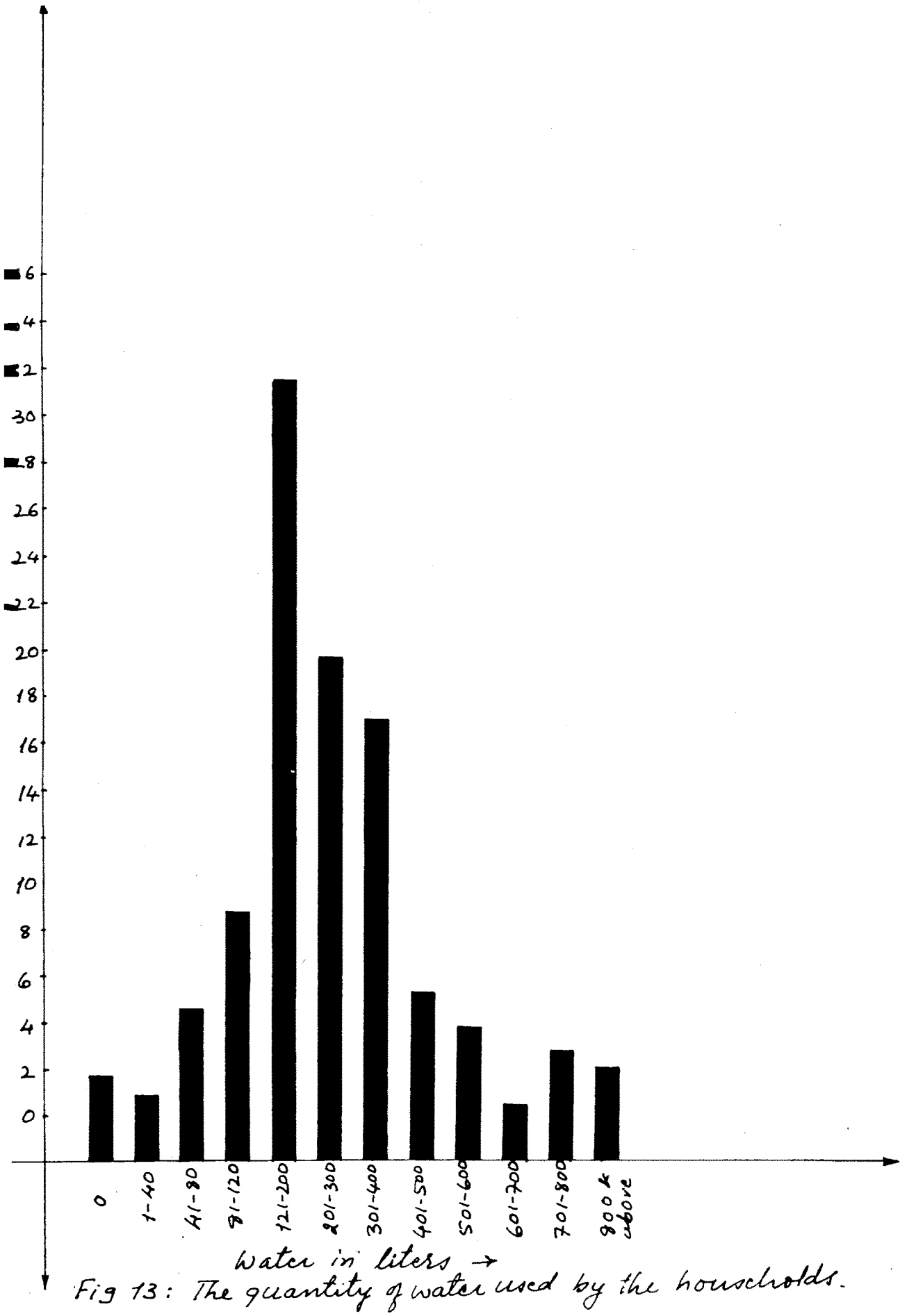

Fig 13: The quantity of water used by the households.

Table No.32 : The percentage of households covering distance in meters (one way) for fetching daily requirement of water.

Sr.No.	Distance (meters)	Household (%)
1.	0 - 50	37.90
2.	51 - 100	15.25
3.	101 - 150	3.26
4.	151 - 200	7.18
5.	201 - 250	2.17
6.	251 - 300	3.92
7.	301 - 400	4.57
8.	401 - 500	15.46
9.	501 - 1000	7.62
10.	1001 - 2000	2.17
11.	2001 - 3000	0.21
12.	3001 - 4000	0.21
13.	4001 - above	-

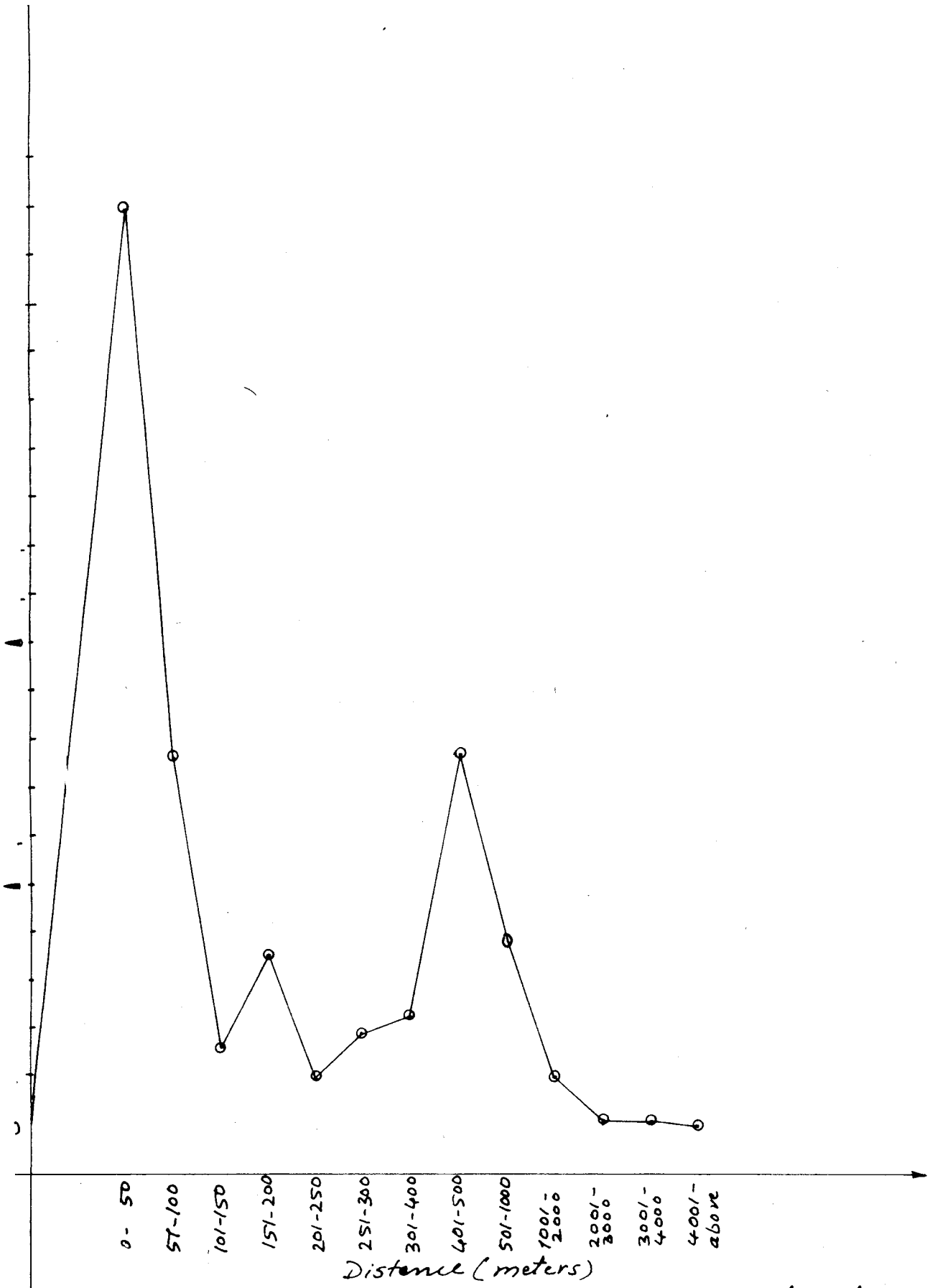

Fig 14: Distance covered (one way) for fetching daily water.

Table No. 33 : The percentage of households spending time for collection of water per day.

Sr.No.	Time in Minutes (Both ways)	Household (%)
1.	00 - 05	22.08
2.	06 - 10	41.18
3.	11 - 15	8.06
4.	16 - 20	13.16
5.	21 - 25	1.06
6.	26 - 30	11.46
7.	31 - 35	-
8.	36 - 40	0.42
9.	41 - 45	-
10.	46 - 50	1.27
11.	51 - 55	-
12.	56 - 60	0.84
13.	61 - 90	0.42
14.	91 and above	-

travelled again depends on the clean source where water was collected. The daily distance travelled (one way) ranged from 0-4000 meters (Fig. 14).

Since the water sources were much near the settlements not much time was spent in collecting the daily water requirements (Table No. 33). A large proportion of households (41.18%) spent only 6-10 minutes to collect their water requirements from the source, whereas (22.08 %) required less than 5 minutes to collect daily water requirements.

The settlements are situated in a such way that in many cases the live spring goes through the village ex. Kathi, Zadoli, Kusawade, Shivandeshwar etc. In general there is better water situation in the study area than most of the dam catchments in the Western Ghats in Maharashtra.

3.13 Fisheries in Shivaji Sagar

River Koyna was not much known for commercial varieties of fresh water fish prior to the creation of the reservoir. However, it does not mean that the river was devoid of fish fauna. Only because there are no reports of any scientific documentation of the fish fauna from the river we can not jump to this conclusion. Interviews with village elders revealed that resident populations did subsist on the local fish catch.

The creation of the reservoir has totally changed the lotic ecosystem into the lentic one. The tall dam wall 78 m.

has become a formidable barrier to the seasonal upstream migrations of fish. Also there is no fish ladder to assist the upstream fish migration. This has apparantly made phenomenol changes in the diversity of fish fauna from the Koyna river.

During the present investigations only commercial fish catches were analysed as experimental fishing in the reservoir could not be done due to lack of resources and manpower. The table no. 7c gives the taxonomic and common names of 32 species of fishes recorded during the commercial fishing operations in the Shivaji Sagar Reservoir. They belonged to 5 orders, 4 sub-orders, 10 families 2 sub families. This fish diversity is considered to be less than the one originally existed from the undamed Koyna river. The lotic fishes species gave way to the lentic forms who have developed in the reservoir along with the four introduced species of commercial fish.

Since 1964 the state fisheries Department has been regularly stocking fish seed of Indian Major Carps, Labeo rohila, Cirrdina mrigala and Catla catla and Common carp Cyprinus carpio. The fish seed stocked so far is 3,251,507 and was mostly in fry stage. This continuous stocking of fish seed is expected to increase the commercial fish biomass of the reservoir. Initially there were no local fishermen who could exploit the fish from the tank on commercial basis.

There were no boats small or big in this area before the impoundment as the river was narrow and shallow during most of

the months. Presently there are about 7 launches, with inboard engines of various horsepower which are used exclusively for fishing. Around 30 small boats made out of 'Shiwari' tree for personal/single fisherman are also used by the local fishermen.

Commercial fish yields vary in season usually daily fish catch of larger boat ranges from 25 to 50 kg and for small boats 2 to 5 kg. During the summer season due to the drop in the water levels in the reservoir and much reduced surface area fish catch increases, which is upto 100 kg and 20 kg per launch and small boat respectively.

During the summer months the water level near the dam drops to 30 meters from the highest level of 78 meters during rainy season. Similarly in summer the reservoir reduces to 1435 ha from the maximum spread of 11,535 ha in the late rainy season.

The fishing gear used is basically of three types 1. drag net, 2. Cast net and in suitable areas 3. dragnets. In many households in the Western Catchment there are nets used for subsistance.

Though slowly the local people are taking interest in fishing, operations, particularly because of the efforts taken by 'Shramajivi Sanghatana' a local Voluntery Organisation trying to develop fisheries in the reservoirs and create employment for local youth who are from non traditional fishermen community like Dhangar, Kunbi, Gosavi, Katkari etc. Traditional fishermen in

the area are Bhoi and Koli and most of these people are involved in subsistance fishing.

Since 1978 fishermen from Andhra Pradesh are seen engaged in fishing operations in the tank during February to May every year. They mainly concentrate on fishing Chela sp. which is largely gatted and sun dried. During this period about 20 fishermen catch upto 500 kg of fish per day.

According to the district fisheries department the number of licenced fishermen of the catchment area are around 200 individuals however not less than 1000 persons from the region depend on the reservoir fishery for subsistance.

There is a great potential for fisheries development in the Shivaji Sagar Reservoir. This will reduce the pressure on other wild animals for animal protein purpose.

3.14 Dam and Local People

The Koyna dam construction has obviously made phenomenal changes in the land holdings in the study area. It can be seen from the table no. 34 that 35.77 % of the respondents lost their lands in submergence or they were aquired by the government for the project. These people were basically from the river basin. A large proportion of the respondents (57.11 %) do not report any change in their land holdings as they are from upper catchment region and did not loose any land in the project. Interestingly a fraction (7.11 %) of the population

Table No. 34 : Change in the land holdings in the study area after the construction of Koyna Dam.

Sr.No.	Increased (%)	Decreased (%)	Remained Same(%)
1.	7.11	35.77	57.11

surveyed had reported increase in their land holdings. This change is attributed to 1. the land of the rehabilitated people which was taken by the residents living behind, 2. Govt. land which has been used year after year on lease basis and has been permanantly occupied and 3. the new lands made available either by encroachments or deforestation in the catchment.

Apparantly the local population is not concerned about the biological diversity i.e. floral and faunal, in the study area. Though the elder respondents reported about the reduction in density or total absence of some animal species in the study area they could not correlate the change to any specific reason.

When asked about the major causes of the change in the animal density and diversity in the region the reasons given were mainly the following kind (Table no.35). The residents considered new settlements, including the project colonies (26.7 %) and road construction (19.2 %) to be the major factors for the distruction of biological diversity. The third important factor was the submergence (9.3 %) of forests and even agriculture, due to the impoundment.

However, interestingly deforestation (7.9 %) and shifting cultivation practices (2.7 %) were not much considered responsible for the degradation of biological diversity of the region. But the observations during the study period were exactly opposite. Since the local population depends on shifting cultivation and also labour from wood cutting to a great extent, they had a bias towards these questions. Also they did not

Table No. 35 : The openions of the residents about the changes caused by dames in the Biological Diversity of the study area.

Sr.No.	Reasons for Change	Positive Openion (%)
1.	Submergence of agriculture and forest	9.3
2.	New settlements	26.7
3.	Shifting cultivation	2.7
4.	Deforestation	7.9
5.	Road construction	19.2

attribute the loss of animal diversity to poaching which takes place around almost every village regularly.

Though it is always mentioned in the large dam project proposals about the upliftment of the society in the region, in fact the picture is always half true. As inveriably it is observed in all the multipurpose river valley projects in the country, it is not the development for the people from the catchment areas but mostly degradation of their existing life standards. This poor illiterate and scattered population from remote areas is not even considered for any future benefits from the project for which they are expected to sacrifice their homes land, subsistance, almost everything.

When the respondents from the study area were asked about their opinions of the impact of Koyna dam on the development of the catchment (Table no.36) except for one or two factors there was hardly any worth mentioning development recorded almost after 30 years of the dam construction. The major changes in the region were only the better electric supply (33.40 %) and improved transportation (23.30 %). Particularly these changes were made near dam site and in part of eastern catchment. Both the changes did not take place in most of the western catchment, and no real significance in the life of the majority of the residents of the area.

The annual income of a household of 6 individuals from agriculture source ranged from 1-500 Rs./year to Rs.10000/- and above (Table No.37, fig.15). For majority of the households(72%)

Table No. 36 : The openions about the developmental impact of Koyna dam construction on life of residents of the study area.

Sr.No.	Developmental changes	Positive Openion (%)
1.	New job opportunity	3.24
2.	Improved transportation	23.30
3.	Better medical facility	8.76
4.	Bazar facility	3.75
5.	Better Electricity supply	33.40
6.	Increased prosparity	1.67
7.	More food production	1.04
8.	More Govt. aid	1.46
9.	Rise in income	1.87

Table No. 37 : Annual income from agriculture per household in the study area.

Sr.No.	Income (Rs./Year)	Household (%)
1.	0	6.47
2.	1 - 500	15.24
3.	501 - 1000	13.98
4.	1001 - 1500	14.61
5.	1501 - 2000	12.52
6.	2001 - 3000	15.65
7.	3001 - 4000	8.35
8.	4001 - 5000	4.80
9.	5001 - 6000	1.78
10.	6001 - 7000	2.92
11.	7001 - 8000	1.04
12.	8001 - 9000	0.62
13.	9001 - 10000	0.62
14.	10000 and above	1.25

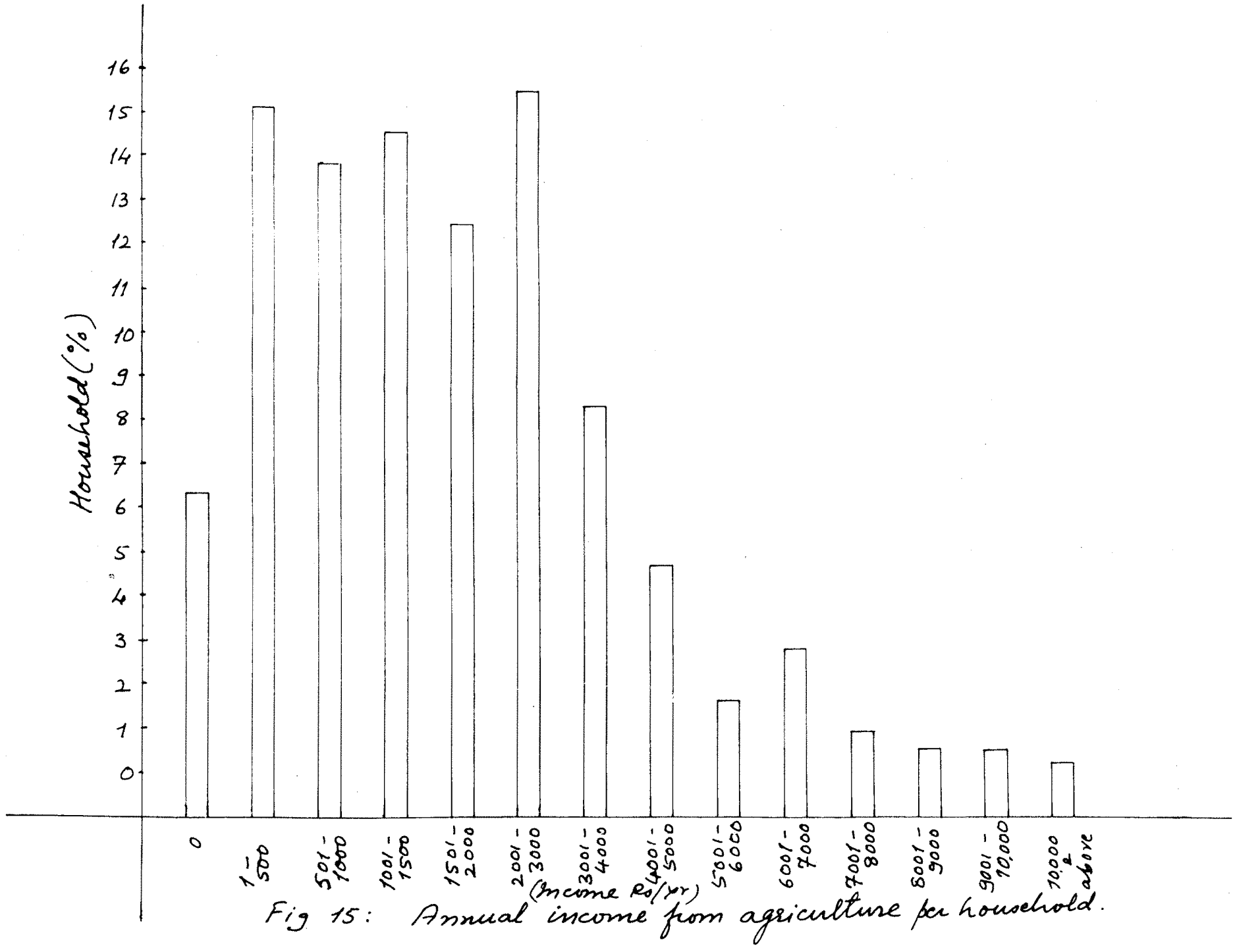

Fig 15: Annual income from agriculture per household.

the annual income from agriculture was below Rs.3000/-. This clearly reflects the uneconomical agriculture practices in the study area. The minute percent of households (1.25 %) who had income more than Rs.10,000/- were the rich families from Kamargaon and Kusawade who had subsequently added new agriculture lands to their original land holdings by purchase of cultivated lands of the local people.

A significant percentage (58.46 %) of the respondents had some income from labour. Basically these were the people who were land less or had unproductive and marginal land holdings. Table No.37b gives the range of households and the annual income they earned from labour. Normally the labour the local people get is from tree cutting for the wood contractors. Though about 11.48 % of the households get an income of Rs.3000/- and above and 25.26 % get Rs.1501-2000 per year, it is very megere considering the hardships in the work. A total of 52.80 % get Rs.1001-3000 per year from labour from wood cutting (Fig.18) when the clear felling and wood cutting will be terminated completely including illicit tree cutting a considerable proportion of households will loose their income.

Some of the household (21 %) reported additional income from sale of forest produce like honey, fuelwood, meat of wildlife, fruits, shikekai, etc. This income was uncertain and temporary. The table no.38 gives the range of this addition income from the source other than agriculture. Figure 16 gives graphical presentation of the same values. Though the income

Table 37b. Income from Labour Rs/Year.

Number of Rs/Year	Persons %
0	41.54
1 - 100	0.20
101 - 200	0.00
201 - 300	0.00
301 - 400	0.62
401 - 500	0.41
501 - 600	2.92
601 - 800	0.00
801 - 1000	1.46
1001 - 1500	8.76
1501 - 2000	25.26
2001 - 3000	7.30
3000 and above	11.48

Table No. 38 : Income per household from other than agriculture.

Sr.No.	Income (Rs./Year)	Household (%)
1.	0	78.91
2.	101 - 200	0.41
3.	201 - 300	0.20
4.	301 - 400	0.00
5.	401 - 500	2.31
6.	501 - 600	0.20
7.	601 - 800	0.62
8.	801 - 1000	1.04
9.	1001 - 1500	2.71
10.	1501 - 2000	13.36
11.	2000 and above	0.20

Table No.39 : The range of total annual income from all sources per household.

Sr.No.	Income (Rs./Year)	Household (%)
1.	0	0.20
2.	1 - 1000	4.59
3.	1001 - 2000	10.85
4.	2001 - 3000	16.91
5.	3001 - 4000	19.41
6.	4001 - 5000	13.98
7.	5001 - 6000	7.51
8.	6001 - 7000	5.63
9.	7001 - 8000	3.96
10.	8001 - 9000	2.92
11.	9001 - 10000	1.25
12.	10000 and above	12.73

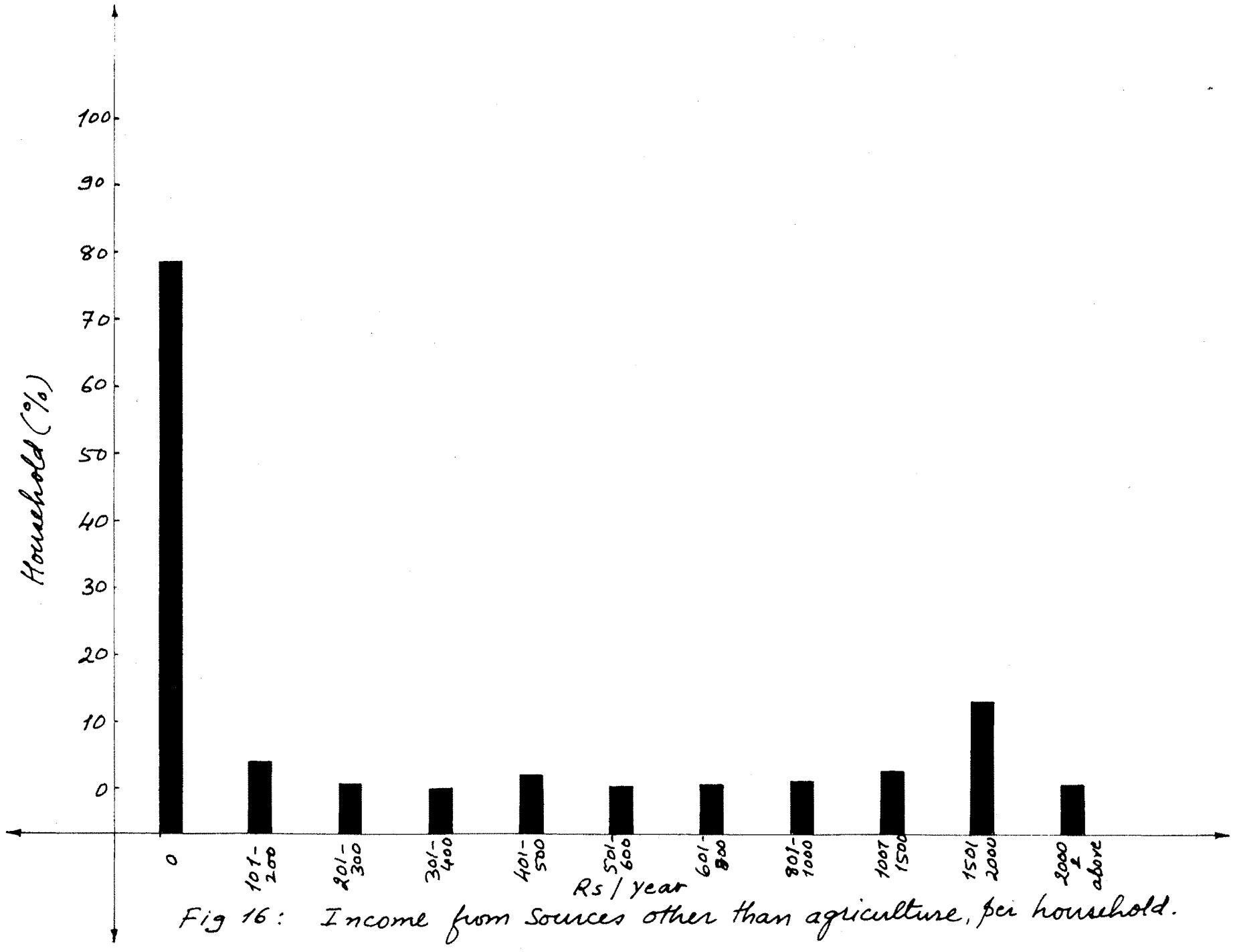

Fig 16: Income from sources other than agriculture, per household.

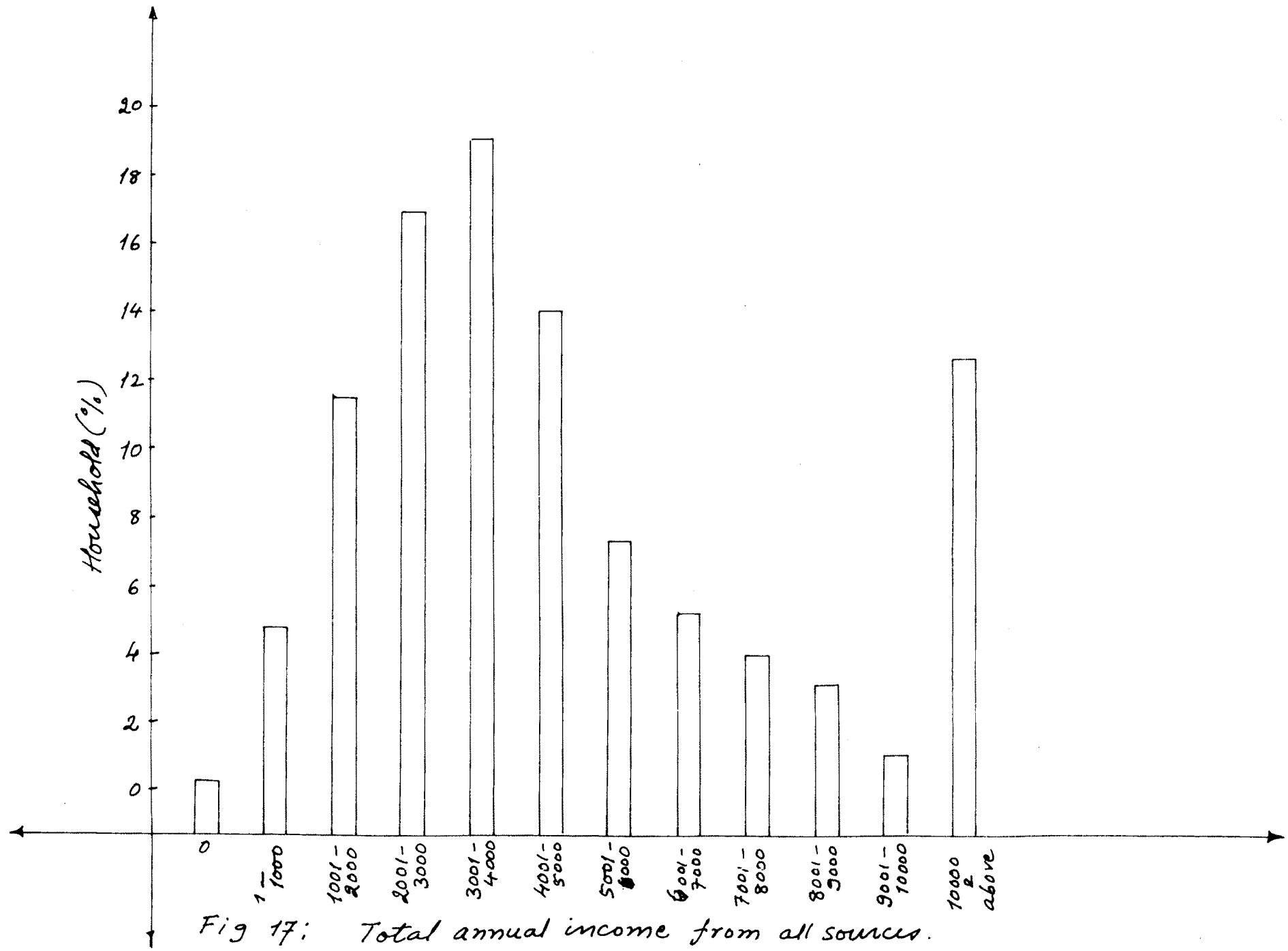

Fig 17: Total annual income from all sources.

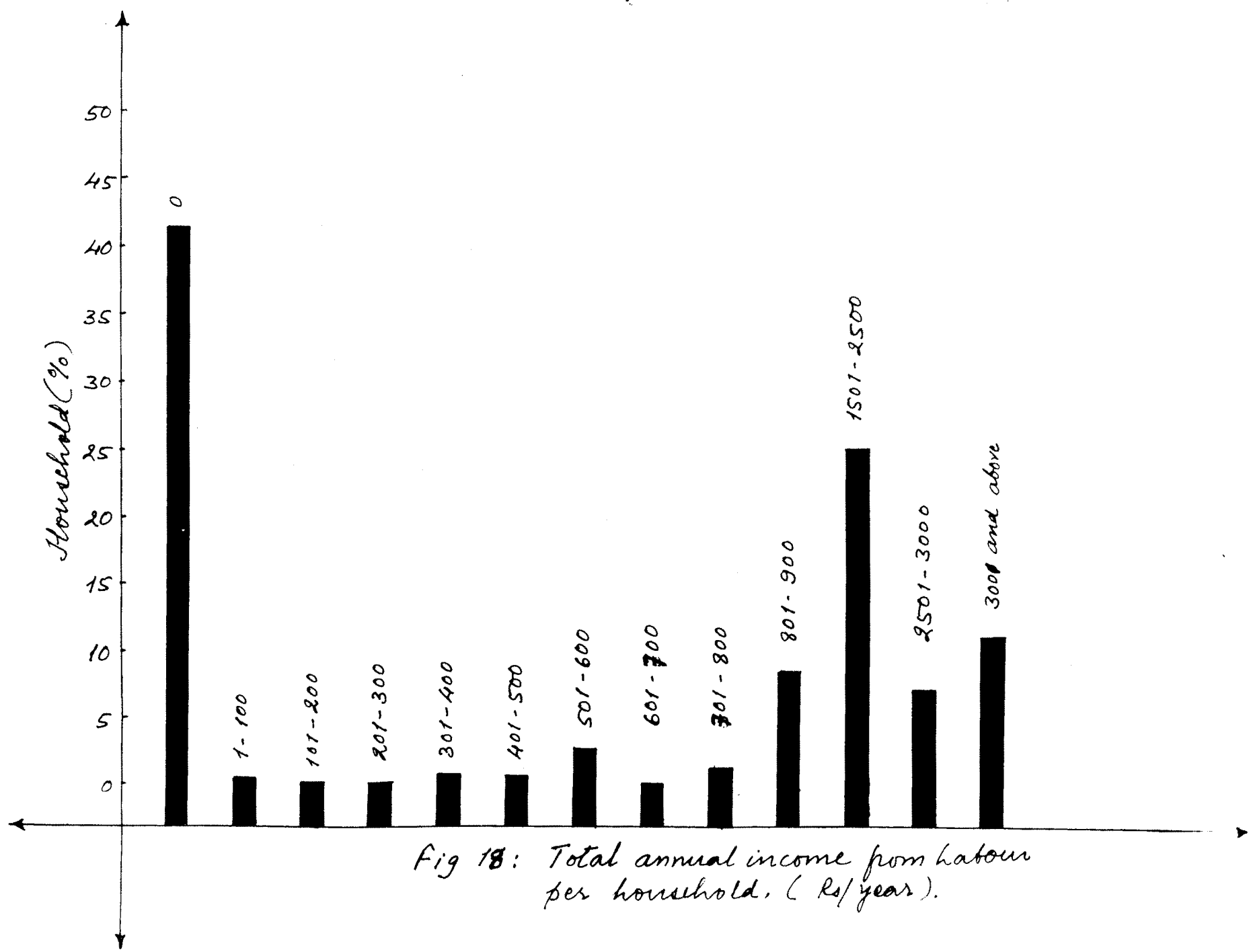

Fig 18: Total annual income from labour per household. (Rs/year).

ranged from Rs.101 to Rs.2000 and above except for one catagory (13.36 %), where the income was between Rs.1501-2000, in other cases it was minor.

The total annual income from all the sources per household ranged from Rs.1-1000 to Rs.10000 and above (Table No.39, fig.17). But most of the households (61.15 %) had annual income from Rs.1001-Rs.5000/-. A total of 74.49 % had the total annual income less than Rs.7000/- per year which is considered to be much below the poverty line (Rs.7800) for a household of 6 individuals, by the planning commission, Govt. of India for the VIIth Five Year Plan.

The figure is self explanatory about the socio-economic status of the residents of the Koyna dam catchment, 30 years after completion of the prestigious hydel project. The 16.9 % of the residents who earned more than Rs.8,000/- per household had some members in service or they were the farmers having larger cultivated lands and other suplimentary income.

The residents of the study area were aware of the region being declared as the Koyna Wildlife Sanctuary and expressed mixed reactions (Table No.41). These opinions were expressed only after detail discussions with the research workers after clearing the doughts of the local people about the sanctuary. All felt that the new change will protect forest and will offer better protection for wildlife (from outsiders?), 99.3 % thought it is good policy because basically the quality of life of these people directly depends on the quality of the environment, forest, water, grass etc. around them. 98.9 % felt this will

Table No.41 : Awareness and the residents about the study area being declared as Koyna Wildlife Sanctuary.

Sr.No.	Openion	Respondents (%)
1.	Good policy	99.3
2.	Will protect forest	100.0
3.	Restrict wood cutting	98.9
4.	Better Wildlife Protection	100.0
5.	Will induce better rains	99.5
6.	Reduce Wildlife Predation and crop pest	98.0
7.	Affects the present life of people	94.36
8.	Sanctuary necessary	86.84

restrict large scale wood cutting by contractors who according to them are responsible for the major and recent deforestation in the area (Plate 14). Surprisingly 99.5 % people felt that betterly conserved forest in the wildlife sanctuary will bring good rains regularly. 98% were of the opinion that the wildlife management will look after the cattle predation and crop pest problems and the affected people will get proper compensation. 94.36 % of the respondents were aware that the wildlife sanctuary lows will bring restrictions on many of the present activities like grazing, fuelwood extraction, poaching etc. Inspite of these expected restrictions in the proposed sanctuary about 86.84 % of the people were in favour of the sanctuary with some conditions.

The people who said that the sanctuary decision was the right step in conservation of the forest in the region have personally experienced the impact of submergence and environmental degradation due to deforestation. Their life in the sanctuary today is much miserable as compared to the life of the people outside the catchment. Most of them know that they are deprived of development after the construction of dam project and have been isolated from rest of the world. Therefore 86.4 % of the people expressed their desire to leave the present area and shift out of the catchment or sanctuary.

When asked about their opinion from the four commonly offered alternatives of compensation for rehabilitation (Table no. 42, fig. 19), only 5 % prefered employment in the sanctuary

Table No. 42 : Choise of local inhabitants in the compensation for the Koyna Wildlife Sanctuary proposal.

Sr.No.	Type of compensation saught	Households (%)
1.	Cash compensation	11.06
2.	Land Compensation	71.80
3.	Employment in the Sanctuary	5.00
4.	Total rehabilitation	69.18

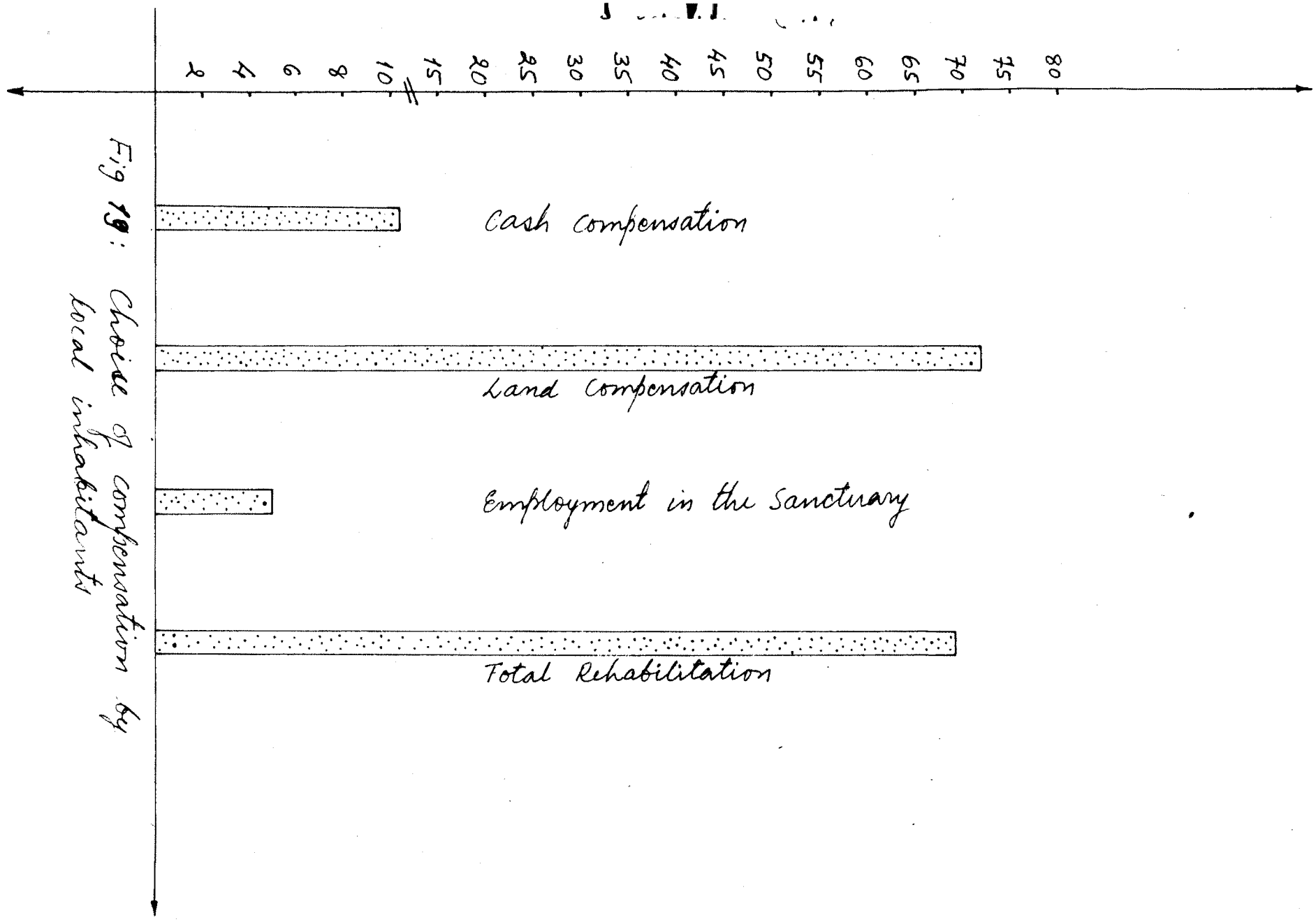

Fig 19: Choice of compensation by local inhabitants

or related developmental activities. The cash compensation was the choice of 11.06 % of the respondents. However, this fraction wanted justifiable compensation with current rates of lands elsewhere and not the meagre compensations given to the Koyna dam affected people in 1960s. Total rehabilitation was the choice of 69.18 % of the respondents who wanted gauranteed housing with all the other facilities and employment or livelihood security. The largest proportion of people i.e.71.80% opted for total compensation in the form of land for land in the command area or any suitable place. All these opinions were expressed carefully with reference to the previous bitter experience in Koyna dam rehabilitations, most of the issues are still pending and problems unsolved even after 30 years of dam construction. While this report was written a massive state wide aggitation was geared up by all political parties and the dam affected people to try to solve at least some of the long pending problems of rehabilitation.