

**ECONOMIC AND ECOLOGICAL IMPACT
OF PANSHET RESERVOIR**
A Study in Problems And Ecodevelopment Alternative

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Preface

Multi-purpose irrigation and hydro-electricity projects have been hailed as milestones on the path of development and progress in the developing countries. However, in the recent years it is questioned as to whether these large reservoirs are an unmixed blessings. The corrosive effects that such large water bodies have on the ecology of the region are being increasingly realised. The destruction of forest and wild life and the displacement of the people in the catchment areas are indeed very heavy costs that are being paid for increasing the supply of irrigation water and electricity. It is now realized that realistic assessment of these costs must be made. With this aim in view a study to examine the ecological and economic impact of deforestation in the Ambi river valley (Pune district) consequent to the construction of a major dam near Panshet village, 40 km.s, west of Pune city was taken up. The study area extended over the entire catchment of the Panshet reservoir and included 24 villages. The results of the investigations into the socio-economic conditions of the dam-affected families and the status of vegetation and other life-forms in the catchment are presented in the following pages.

The various facets of the problem under consideration are discussed in Chapter I. In Chapter II some background information relating to the physical setting - topography, rainfall, soils etc., is presented. The IIIrd Chapter discusses

the changes in the vegetation in the Western Ghat region and the present-day vegetation of the catchment area which is divided into four zones considering the geo-physical conditions.

The economic activities of the people, levels of production in various activities viz., cultivation, forest exploitation, livestock rearing, living conditions, health status of the inhabitants and the problems they face are detailed in Chapter IV. Case studies of villages Kuravati from Zone I, Shirkoli from Zone II and Mangaon from Zone III were carried out to get a deeper insight into the characteristics and status of plant life in each zone. Suggestions for redevelopment are made taking into consideration the present situation. These are presented in Chapter V. In Chapter VI the alternatives for the redevelopment of the entire region are formulated keeping in view the economic and ecological considerations. Recommendations flowing from the study are presented in the last Chapter.

This research project was funded by the Department of Environment, Government of India and we gratefully acknowledge the receipt of the research grant. We would like to place on record our gratitude to all the households approached for interview who whole-heartedly cooperated and supplied us the necessary information. We are thankful to the officials of the irrigation department, forest department, rehabilitation office, Velhe Panchayat Samiti, Poona District Milk Producers'

Cooperative, the talathis of various villages for providing us the official statistics from their records, and the staff of the soil testing laboratory in Agricultural College, for their kind help in the analysis of soil samples.

Discussions, and field trips together with Shri Prakash Gole, Smt. Swati Gole, Dr. V.D.Vartak, Dr. Madhav Gadgil and Dr. Gunale at different stages of the work were of great help. We are grateful to them for their valuable suggestions and comments. Thanks are due to Shri A.V.Gogte who shared the main responsibility of the investigational work and Smt.Rajani Gangal who neatly typed the Report.

1 August 1986

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CHAPTER I

The Problem

Irrigation is considered a panacea in the Indian subcontinent where the rains are restricted to the monsoon season and irrigation systems have been developed since ancient times. These were mainly in the nature of diversion channels, surface-drainage tanks and wells. Alongside the small control works on the minor rivers there were some major works of great engineering excellence like the Grand Anicut, built on the Cauvery river during the 2nd century A.D. Except for the few major anicut systems and big irrigation tanks and some long inundation canals, the extensive traditional irrigation arrangement consisted of crude structures of stone and earth, bamboo and brick. However the crude tanks often formed such interconnected chains that every bit of the run-off water flowing through the vast landscapes was appropriated for irrigation. (Sengupta, 1985) The great majority of the irrigation works were locally managed.

After the imposition of the colonial rule, the recurrence of severe famines forced the Government to provide, what was originally considered as, selective protective irrigation. The civil engineers were put in charge of the development of these irrigation works. There was an over emphasis on the engineering aspects at the cost of environmental considerations, efficient crop practices and local management. The stress on the engineering aspects and bureaucratic management

of the irrigation works has persisted even in the post-independence period. Moreover, the increased interest in the hydel power led to the acceptance of multipurpose river valley projects often with adverse effects on irrigation and agriculture. The country invested since 1950 till 1980 about Rs. 7,510 crores in the major and medium irrigation projects creating an irrigation potential of about 16.9 million hectares, giving rise in its wake to several complex problems. It is estimated that nearly seven million hectares of land have gone out of production because of salinity and additional six million hectares are affected by water logging. (Agarwal, et al ed. 1982) In addition aquatic weeds are posing a serious threat to most of the canal irrigation projects. The problems of destruction of forests, resulting in severe soil erosion and rapid siltation of reservoir, and increased incidence of floods are assuming serious proportions. Last but the most important aspect is the loss of vast agricultural lands due to inundation and the displacement of thousands of peasants from their native lands ruining their life as rehabilitation measures have been extremely perfunctory and inadequate. Consequently an urgent need to examine the impact - both ecological and economic - of the major irrigation projects has arisen. The present project was taken up with the aim of conducting an in-depth study of one of the major irrigation projects located in the Western Ghats.

It may be noted that in the post-1950 period, the choice of location of big dams in the Western Ghat region often fell on such places where the streams flow through a narrow neck in the spurs of a mountain chain just before they emerge into the broad plains so as to minimize the length of the dam. Such places offer another benefit - generation of electricity is easy. In the Pune district the dams like Bhatghar, Khadakwasala built a century back were located at places after the rivers crossed the narrow mountain neck. However, the new dams in the district viz., Panshet, Warasgaon, Pawana are constructed at points where the stream flows through a narrow neck in the mountain. The catchment of these dams is an area of very high rainfall (over 5000 mm.) where chemical weathering gives rise to a large amount of clayey material which becomes a source for siltation of the reservoir. In addition, the high relief causes accelerated processes of mass movement leading to the dislodgement of the coarse debris which accumulates on the valley floor and lower slopes. The rate of siltation is thus considerably high in such locations. The situation gets worse as the trees on the lower slopes are cut down as the exact line of submergence is not known, and those on the middle and upper slopes, due to the pressure of shifting cultivation because of the loss of the rich rice lands in the valley. Loss of one hectare of rice land means that about two hectares have to be brought under (shifting) cultivation because of the low productivity of the uplands. If the total land needed during the cultivation cycle (which extends

over 7 to 10 years) is considered about 15 to 20 hectares get affected to replace the produce of one hectare of rice. The construction of a dam at the neck of the mountain thus means a large-scale destruction of the vegetative cover in the catchment area that leads to acceleration of the rate of siltation. The back waters of such dams stretch many kilometres into the mountains right upto the source of the streams. At the confluence of the numerous small tributories of the river rising in the mountains and the reservoir, small delta of silt deposits are formed. The impounding of water in the mountain neck also affects the water balance in the downstream parts which are almost turned dry because of the large storage at the source.

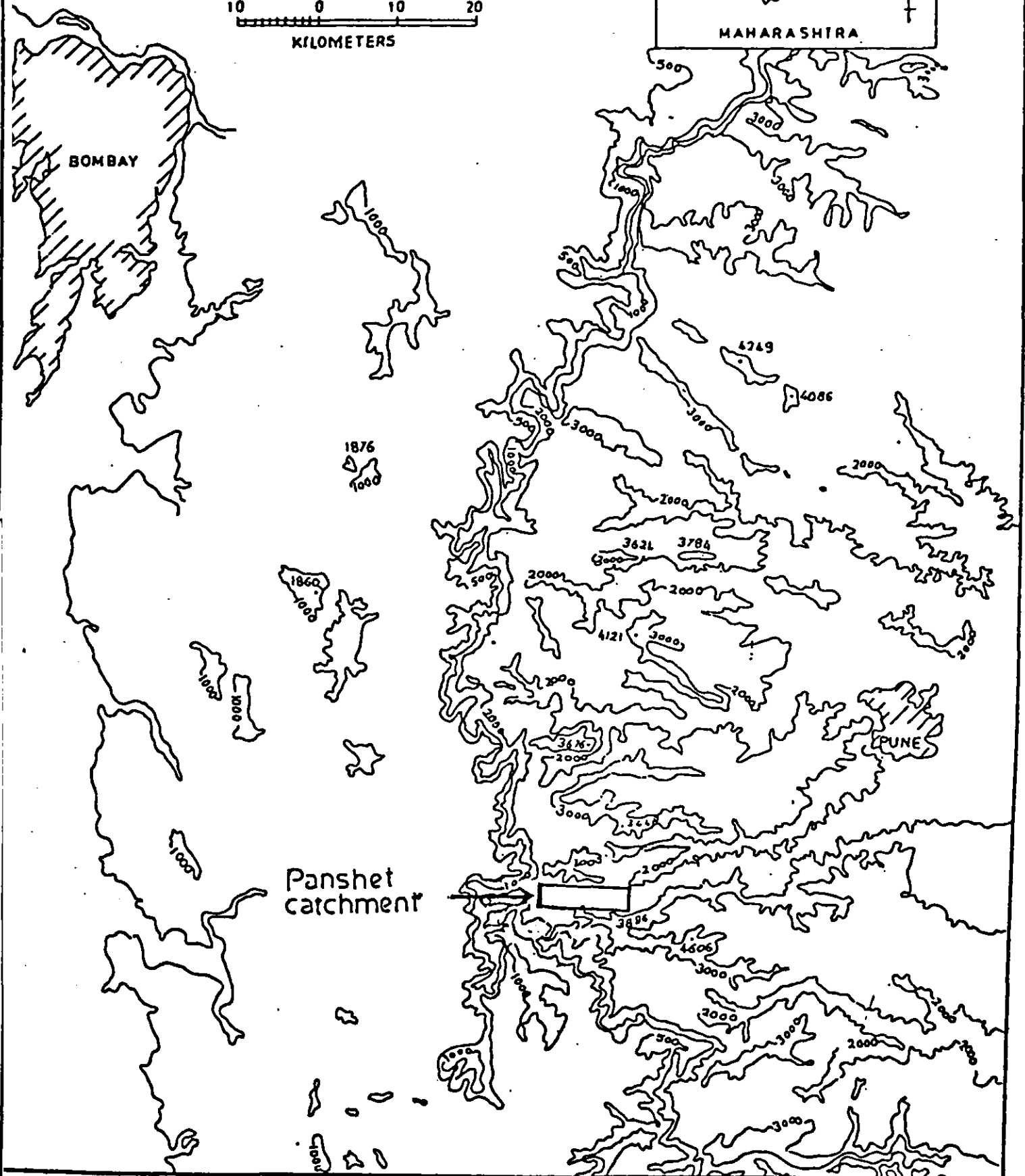
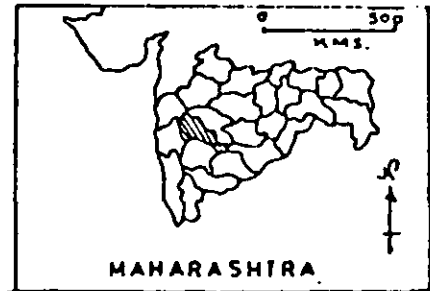
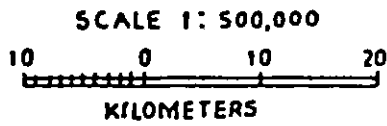
Submergence of valley floors means displacement of the people depending upon cultivation in the valleys; it also leads to the destruction of forest and subsequently to the disappearance of wild life. The corrosive effects of large reservoirs on the ecology of the region and the disastrous effects on the life of the displaced people are nearly ignored when such dam projects are taken up.

The present study attempts to examine the status and conditions of different life-forms with special emphasis on the life of the people from the catchment area of one such dam in Maharashtra. (Map 1) This dam impounds waters of the river Ambi which originates in the Western Ghats near village Dapsare

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Location Map

PANSHET CATCHMENT



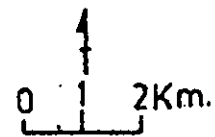
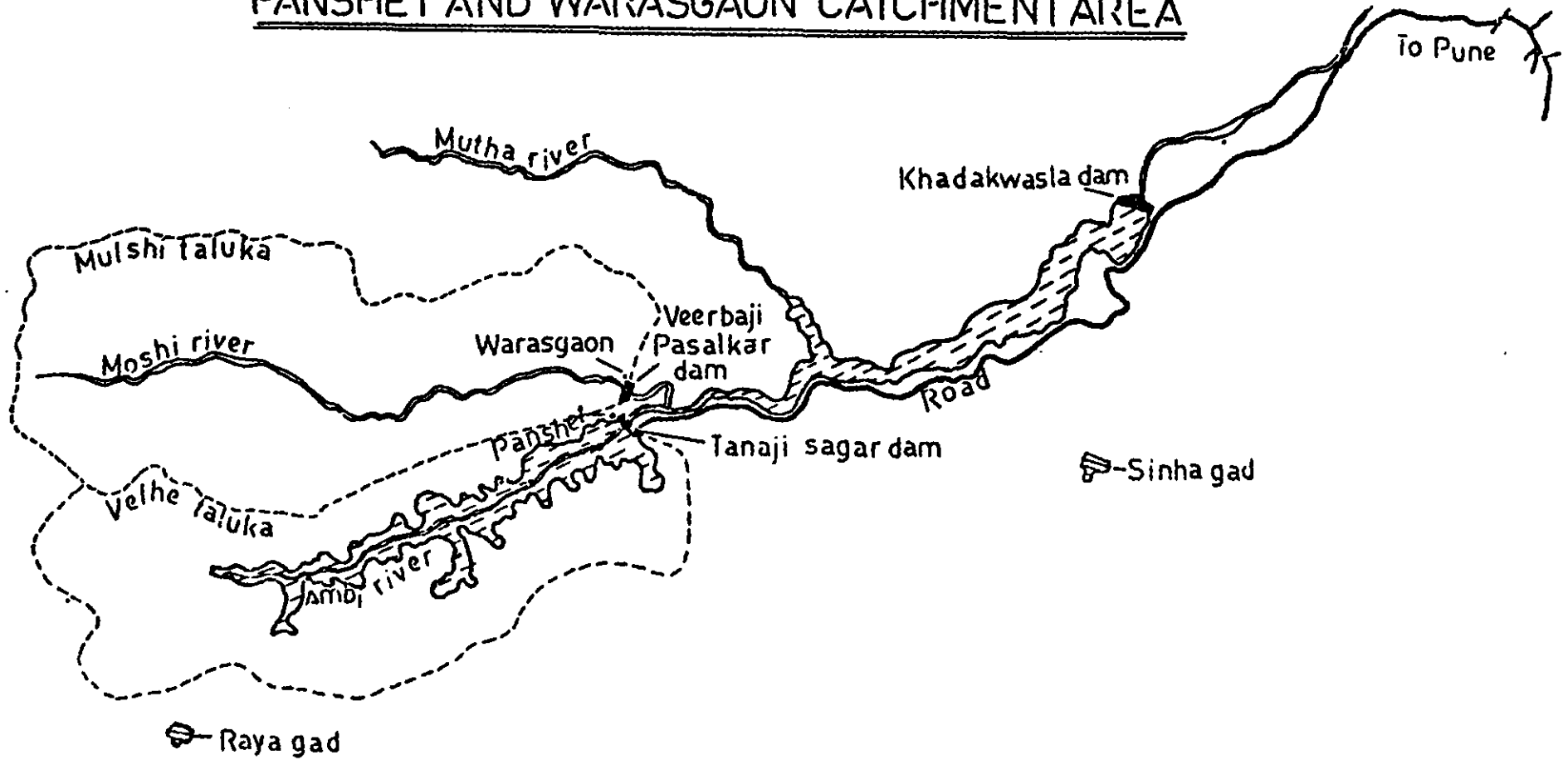
(Lat. N $18^{\circ} 20''$, Longitude E $73^{\circ} 25''$) at the height of about 1200 metres. The dam is constructed near Panshet village at a place where the valley of the river is reduced to a narrow neck by cross-spurs radiating from the main ridge of the Western Ghats. The adjoining valley of the river Moshi provided similar neck where another dam viz., Warasgaon is located. (Map 2) The work on the Warasgaon dam is yet to be completed. In 1986 monsoon the reservoir was partially filled up.

The Panshet dam is located at a distance of 40 kilometres to the West of Pune city. It is a 730 metre long and 60 metre high earthen and masonry dam and impounds a maximum of 304 million cubic metres of water. The reservoir is named after Tanaji - the famous lieutenant of Shivaji. Back-waters of Tanajisagar stretch 25 kilometres into the mountains and at its full capacity the water level touches the main ridge of the Western Ghats at the Western extremity of the catchment. The catchment of the Panshet dam extends over an area of 120 sq.kms. (Map 3) Tanajisagar is a storage reservoir from which water is released into the Khadakwasla reservoir from about the month of November-December till May-~~June~~.

The basic problems that the catchment area is facing are (1) Deforestation of the hill slopes is accelerating the rate of siltation of the reservoir. The loss of top soil means that increasing area is being turned unfit for cultivation. (2) The

Map. 2

PANSHET AND WARASGAON CATCHMENT AREA



severe interference with the plant life has resulted in the deterioration of plant life and loss of wild life. (3) The loss of soil and denudation of vegetation has adverse effects on the viability of economic activity of the population living in the catchment area. The inhabitants are forced, due to the resource-scarcity, to encroach upon the existing slender resources to eke out a living; this is leading to a further degradation of the natural resources. This downward spiral of deterioration of resource base and immiserization of the people has to be stopped urgently. The alternatives are explored on the basis of a detailed study of the status of the existing resources and the economic activities of the people.



1. Gully Formation near Kuravati



2. Panshet Reservoir in Summer

CHAPTER II

The Physical Setting

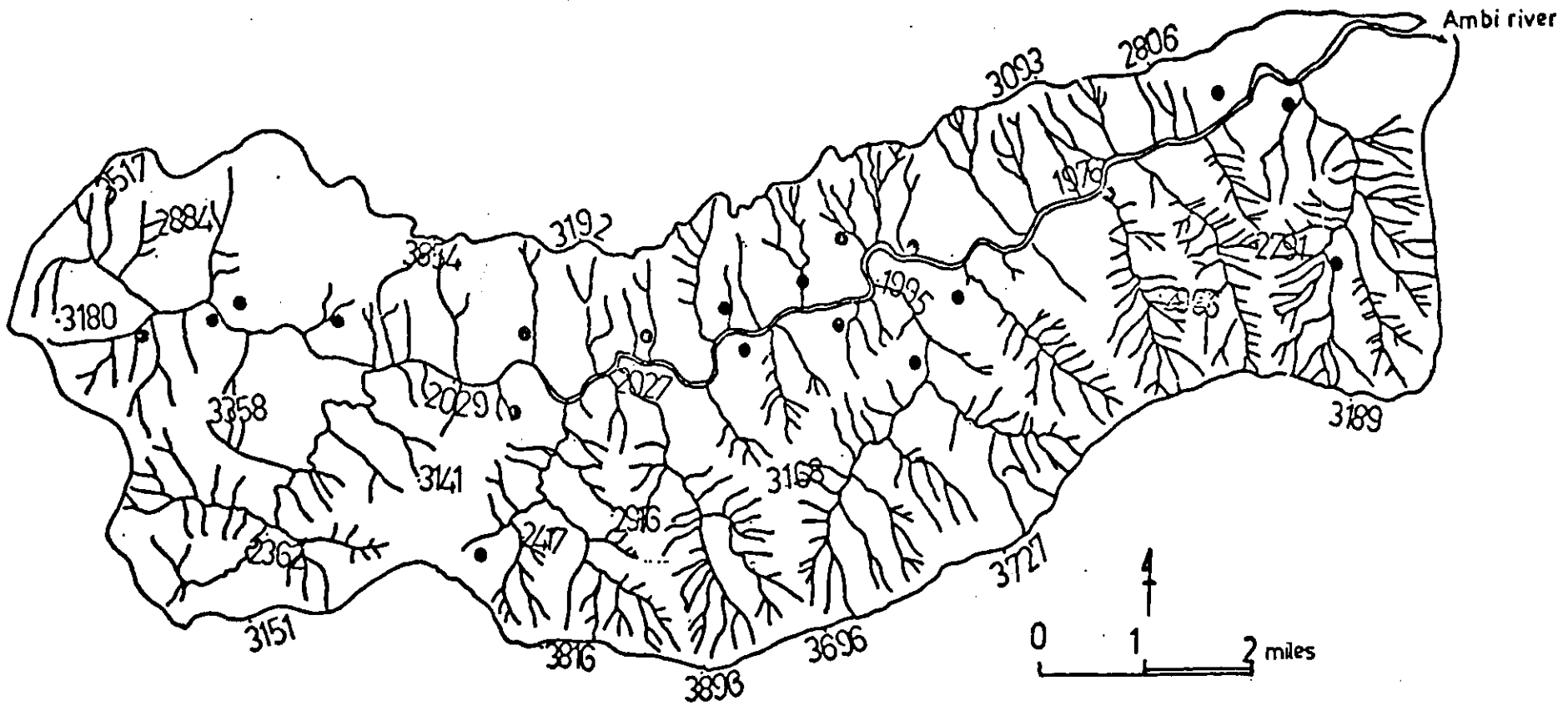
1. The Western Ghats:

The Western Ghats constitute a continuous chain of hills stretching north-south along the west coast of India, for a distance of over 1000 km.s. The Ghats present a formidable barrier to the monsoon winds that come in from the south-west after collecting a lot of moisture over the Arabian sea. Thus during the rainy season the effect of the ridge of the Western Ghats is not only to cause excessive precipitation on the ridge itself, but also to create a rain-shadow to the leeward side so that there is an amazingly sudden drop in the rainfall on the eastern side. Many of the famous east-flowing rivers including the Krishna and the Godavari and their tributaries such as the Bheema and the Koyana, originate on the ridge of the Western Ghats. The Ambi with its source near Dapsare on the main ridge, is a tributary of the Mutha which flows through the Pune city and meets the Mula and later the Bheema further downstream. The Bheema joins the Krishna flowing into the Bay of Bengal.

The 120.30 sq.km.s catchment area (Lat. $18^{\circ} 20''$ and longitude E $73^{\circ} 25''$ to $73^{\circ} 40''$) of the Panshet dam is surrounded by spurs that radiate from the main ridge of the Western Ghats and rise to heights of 1000 to 1200 metres. (Map 4) The

Map-4

PANSHET CATCHMENT: DRAINAGE MAP



Figures indicate height in feet above sea level

highest peak in the catchment with a height of 1170 metres is situated between Mangaon and Thangaon on the right bank of the river.

The total area occupied by the 24 villages in the catchment was 11303 hectares. Of this, 1825 hectares were acquired for the reservoir; of the remaining, 6677 hectares are under private holdings, and 2801 hectares are under the control of the Forest Department. The nature of the terrain of the catchment will be appreciated better if the slope is taken into account. (Table 2.1) The degree of slope at different points in the catchment is shown in Map 5.

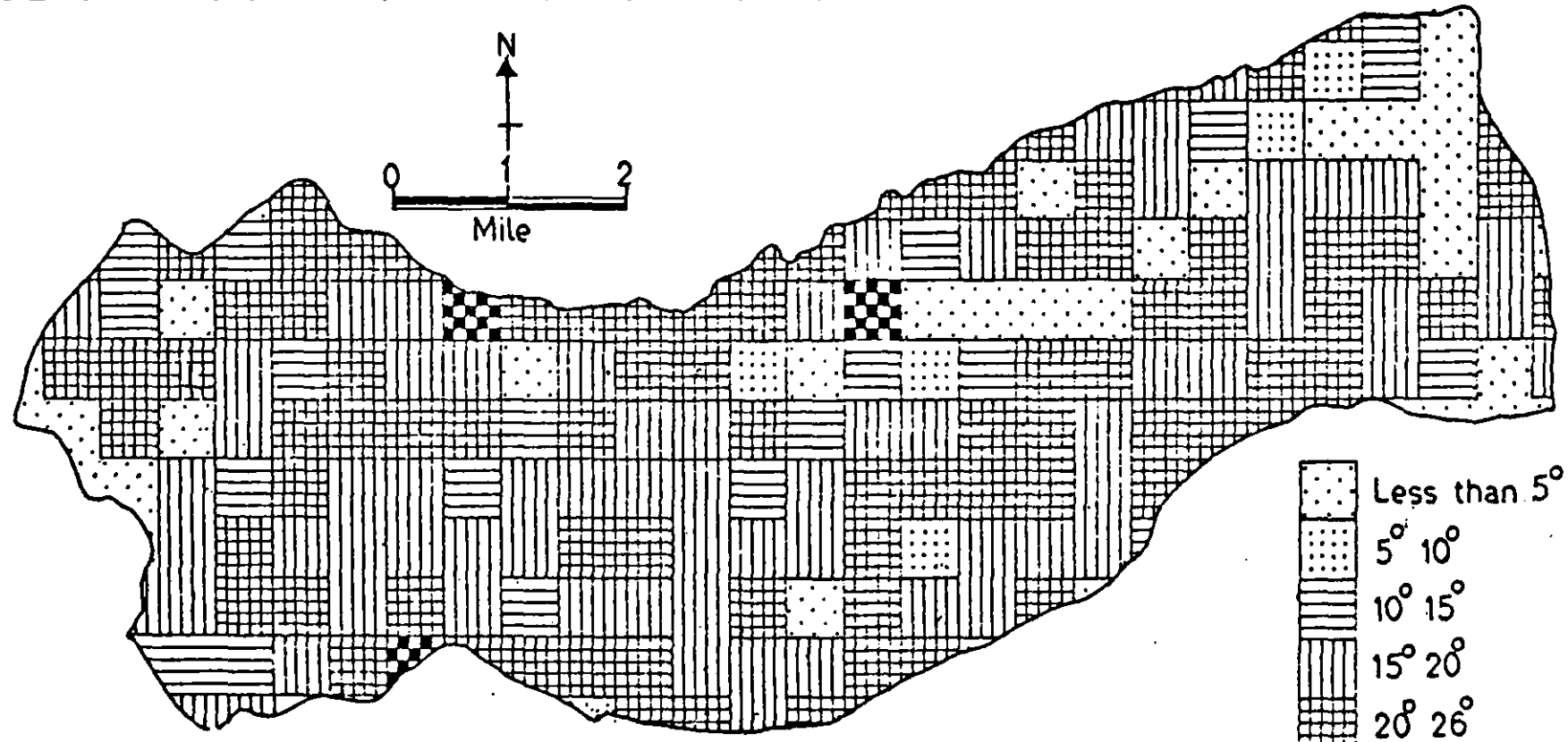
Table 2.1: Distribution of the Area Under Panshet Catchment by Degree of Slope

Degree of Slope	Area covered in sq.km.s	Area covered as percentage of total area
Less than 5°	15.4	12.77
5° to 10°	3.3	2.76
11° to 15°	11.4	9.51
16° to 20°	43.5	36.16
21° to 25°	45.3	37.65
26° & above	1.4	1.15

It will be seen from the table that more than 65 per cent of the area of the catchment has a slope of more than 15°.

Map 5

SLOPE MAP OF PANSHET CATCHMENT



	Less than 5°
	5° 10°
	10° 15°
	15° 20°
	20° 26°
	26° & above

Moreover if the slope map is superimposed on the map showing the spread of the reservoir, it becomes apparent that most of the flat land, i.e. land having a slope of upto 10° is submerged under the reservoir. The land with slopes below 15° that remains above the reservoir level is only about eight per cent of the total area. Only so much land may be termed as suitable for agriculture. On the remaining land, which is steeply sloping, agricultural operations are difficult and costly, and also not advisable from ecological point of view.

2. Geology:

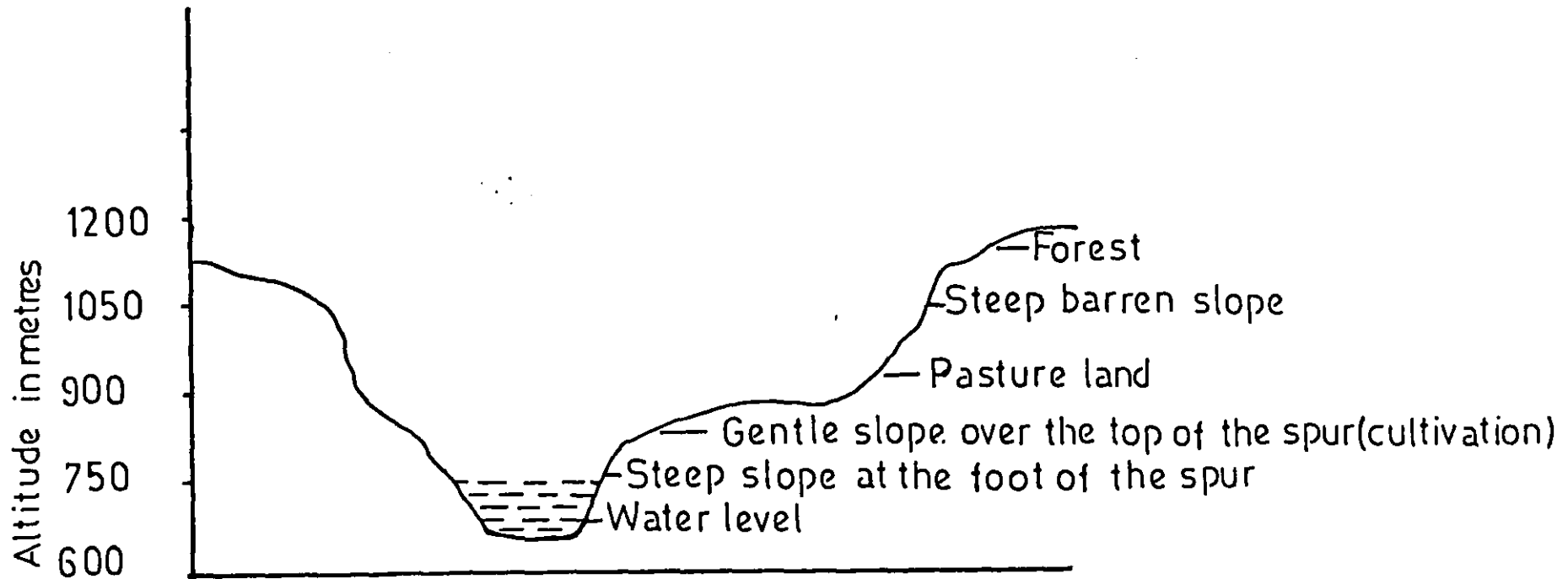
The catchment area forms a part of the great trap region of the Deccan. Deccan trap is the result of volcanic lava flows. The lava was poured out of long and narrow fissures during the upper Cretaceous or Lower Eocene period. Beds of Basalt and Amygdaloid alternate, the upper and lower planes being strikingly parallel to each other. Basalt, which covers almost 90 per cent of the area is normally dark grey or blue grey in colour. The rock weathers into a disintegrated form known as murrum and finally produces soils of varying depth, texture and colour.

3. Rainfall:

The Western rim of the catchment is exposed to the full force of the south-west monsoon and receives torrential rains during the period June to September. The rainfall however, decreases rapidly towards the east so much so that Panshet

Fig 21

LANDUSE PATTERN IN THE AMBI RIVER VALLEY



which is only 25 km.s from Dapsare as the crow flies, receives less than one-fourth of the total rainfall annually recorded at Dapsare. This is well illustrated by the rainfall data given in Table 2.2. The rainfall figures in the table refer to the total rainfall during the monsoon period i.e. June to September and the total annual rainfall of seven years recorded at four stations in the catchment area. It will be seen from Table 2.2 that the village Dapsare experiences the highest rainfall (annual average 9193 mm.s). Further east at Mangaon and Shirkoli the precipitation drops to the average annual rainfall of 5446 mm.s and 3630 mm.s respectively; while still further east at Panshet the annual average drops to only 2157 mm.s. The south-west monsoon breaks generally in the first or second week of June. The highest rainfall is recorded generally during the second fortnight of July or the first fortnight of August. Some rain occurs during the storms that follow the retreating monsoon in October. Winter season and summer season are generally dry.

In the assessment of the total quantities of rainfall over large areas, it is necessary to convert many point values to give the average rainfall depth over a certain area. The Thiessen Polygon defines the zone of influence of each rain-gauge station by drawing lines between pairs of rain-gauges, bisecting the lines with perpendiculars and assuming all the

Table 22

The Pattern Of Annual Rainfall In The Panshet Catchment Area (in mm.)

From East

To

West

Year	P A N S H E T		S H I R K O L I		M A N G A O N		D A P S A R E	
	Monsoon Rainfall	Annual Rainfall	Monsoon Rainfall	Annual Rainfall	Monsoon Rainfall	Annual Rainfall	Monsoon Rainfall	Annual Rainfall
1960	1787.64	-	2829.6	3000.0	4473.70	-	6352.49	6352.49
1977	1816.70	1952.50	3348.9	3381.2	4528.90	-	7056.20	7056.20
1978	2057.60	2156.9	2931.0	3009.2	7479.20	7501.3	8842.20	9602.40
1979	1891.40	2042.7	2835.73	-	4117.20	4229.2	8456.60	9042.60
1980	2504.20	2615.7	5003.80	5052.5	6941.20	6990.8	14577.90	14648.80
1981	2284.80	2674.4	3691.6	3697.0	4682.10	4712.5	9758.0	9758.0
1982	1241.50	1499.90	3388.6	3641.8	3580.20	3750.0	7557.4	7897.0
Total	13583.84	12942.10	24029.23	21782.7	32802.50	27233.8	62600.79	64357.49
Average	1940.54	2157.0	3432.74	3630.45	4686.07	5446.76	8942.97	9193.92

Source: Irrigation Department, Government of Maharashtra.

area enclosed within the boundary formed by these intersecting perpendiculars has had rainfall of the same amount as the enclosed gauge (Wilson, 1974). To obtain the total volume of rainwater received in the zone of influence of a particular rain-gauge, the total amount of rainfall on each rainy day is to be multiplied by the area of the zone. The total volume for the whole catchment will be obtained by adding the total volumes on each rainy day for all the rain-gauge stations in the catchment. The zone of influence of each rain-gauge station in the catchment is shown in Map 6. In the year 1982 i.e. the year preceding the beginning of the present enquiry the total volume of rain-water for the whole catchment computed by this method came to 47.34 million cubic metres. This gives some idea of the rainfall input for the whole catchment during a particular year.

4. Soil:

Soils are locally classified as black, red and grey (barad). The three classes of soil blend with each other in varying proportions and in turn are modified by sand, gravel, lime, salts and other ingredients. The black soils generally belong to the flat eastern part of the Pune district rather than to the hilly west, and commonly occur in layers several feet deep covering a wide area. Poorer black soils are mixed with sand and clay. The red soils are generally shallow and coarser than the black and often spoilt by a mixture of gravel.

The grey soil occurs, chiefly on the slopes and uplands of the north-east and the east. It is coarse, gravelly and of a loose, friable character. Soils produced from murrum mostly lack in humus, are non-acid and naturally well-drained by the underlying murrum. The poorer soils have much partially disintegrated rock still present and large boulders are common.

In the study area the general soil colour is reddish-brown tending to black nearer the valley bottom. The soil exhibits a mixture of murrum, clay and silt. Well developed soil profile is almost absent in the whole region. Soils are immature in character. Since the gradient is high the denudational processes become active on the valley slopes. The soils are transported soils and are coarse in texture. Chemical weathering is evident in this area. This is the result of the heavy rainfall. Chemical weathering gives rise to a large amount of clayey material which becomes a source for the siltation of the reservoir. Soils are leached and therefore lateritic in character. The soil depth varies from place to place, ranging from a thin film to a depth of more than half a metre. On steep slopes unprotected by tree cover and exploited for cultivation, the soil is only a few cm.s deep. On natural terraces and in fields that are banded and terraced for cultivation, the soil which is displaced from the steeper slopes above, is found to be accumulated. In general the upper slopes are more exposed and barren and consequently have thinner soils, than the lower slopes.

At Dapsare which is situated at a height of about 1000 metres and which has the highest rainfall in the catchment, rock is exposed wherever the soil lacks vegetative cover. In sacred groves which are better preserved, the depth of soil is better also. Reserved forest areas however, have been encroached upon and opened up resulting in poor soil depth. To test the soil, samples were collected from the cultivated fields situated at various heights and slopes, and from the sacred groves. The soil samples were collected at Panshet, Kuravati, Shirkoli, Kambegi, Kasedi and Dapsare. 15 samples were taken from each of the four zones.

To obtain a composite sample, small portions of samples were collected upto the desired depth from atleast 5-10 wells, after scraping the surface litter. The soil was then, thoroughly mixed and about 500 gms were collected in polythene bags. One field was generally treated as one sampling unit. The soil analysis for all the collected samples was carried out in the department of soil science, College of Agriculture, Pune. The following properties of soils are studied.

- (1) pH (Glass electrode)
- (2) Total soluble salts (conductivity bridge)
- (3) Organic carbon (Photo electric Calorimeter)
- (4) Available potash (Flame-photometer)
- (5) Available phosphoric acid (Photo electric Calorimeter)

By using the above methods as given by Jackson (1973), the soil samples were analysed. The analysis shows that rainfall together with the practice of shifting cultivation, exerts an influence on the soil character. With the increase in the rainfall, there is an increase in the soil acidity, organic carbon content and potash content. The increase in acidity is due to leaching of soluble salts, especially calcium carbonate. In general the soils from the low rainfall sector are neutral with low contents of organic carbon and potash. In the adjacent sector of moderate rainfall the soil is moderately acidic, has moderate organic content and potash content but a high content of phosphorous. Soil in the high rainfall sector shows an increase in the acidity but is otherwise not much different from the soil in the sector with medium rainfall.

Table 2.4 gives the results of the analysis of soil samples from various sacred groves in the catchment. Of the sacred groves located in the study area, those where soil samples were taken and studied, are more or less well-preserved. The analysis shows that the soil in these groves is qualitatively better than the soils in the cultivated areas and in lands lying fallow over varied periods. Soils which show slight to moderate acidity (pH 5.6 to 6.9) are considered good for tree growth as they exhibit relatively greater activity of micro-organisms and higher availability of mineral nutrients.

Table 2.3: Analysis of Soil Samples Collected in the Cultivated Fields from the Four Zones in the Catchment Area of Panshet Dam

Zone	pH	Soluble salts	Organic carbon kg/ha	Potash kg/ha	Phosphorous kg/ha
I	6.86	0.15	0.435	249.73	15.733
II	6.31	0.082	0.724	296.66	35.733
III	5.70	0.15	na	na	na
IV	5.48	0.15	0.832	384.20	14.200

Source: Field Study

Table 2.4: Analysis of Soil Samples Collected from Different Sacred Groves in the Study Area

Sacred Grove	Village	pH	Soluble salts kg/ha?	Organic carbon kg/ha	Potash kg/ha	Phosphorous kg/ha
Shirkai	Shirkoli	6.2	0.052	0.96	946	52
Mhasoba	Shirkoli	6.8	0.084	1.00	403	52
Givashi	Givashi	6.7	0.082	0.79	672	45
Janni	Mangaon	5.8	0.15	1.24	986	50
Kothambi	Dapsare	5.6	0.15	1.26	1047	13
Jakhin	Dapsare	5.6	0.15	0.63	829	20
Viroba	Ambegaon	5.7	0.15	0.94	1120	29
Jingoba	Shirkoli	6.8	0.012	1.10	543	41
Average values		6.1	0.103	0.99	750	38

Source: Field Study

5. Temperature, Humidity and Wind Velocity:

While rainfall data are available from different rain-gauging stations in the catchment, temperature data are not being regularly maintained and hence not available. However, maximum and minimum temperatures recorded at Panshet from time to time range around 41° C. at their highest during April and May and reach as low as 6° C. in December and January. Water temperatures of reservoir are available and are shown in Table 2.5 together with the relative humidity and wind velocity at Panshet. The relative humidity ranges between 37 per cent - 78 per cent, the lowest is recorded in May and the highest is recorded in August and September.

6. Zonal Division:

The most outstanding feature of the catchment is the changing patterns of vegetation with changing rainfall. The catchment area can be divided into four zones taking into account the annual precipitation and the vegetation.

The first zone which is subjected to severe biotic interference extends from the dam site to village Dhindli on the southern bank and Ambegaon (Kd) on the northern bank. It experiences an annual rainfall ranging between 2000 mm to 3000 mm.s. The zone is mostly dominated by grasses. The second zone extends westwards upto the village Thangaon on the southern bank and Bhalawadi on the northern bank. This



3. Barren Hill Slopes in Zone I



4. Parched Forest Land in Zone I



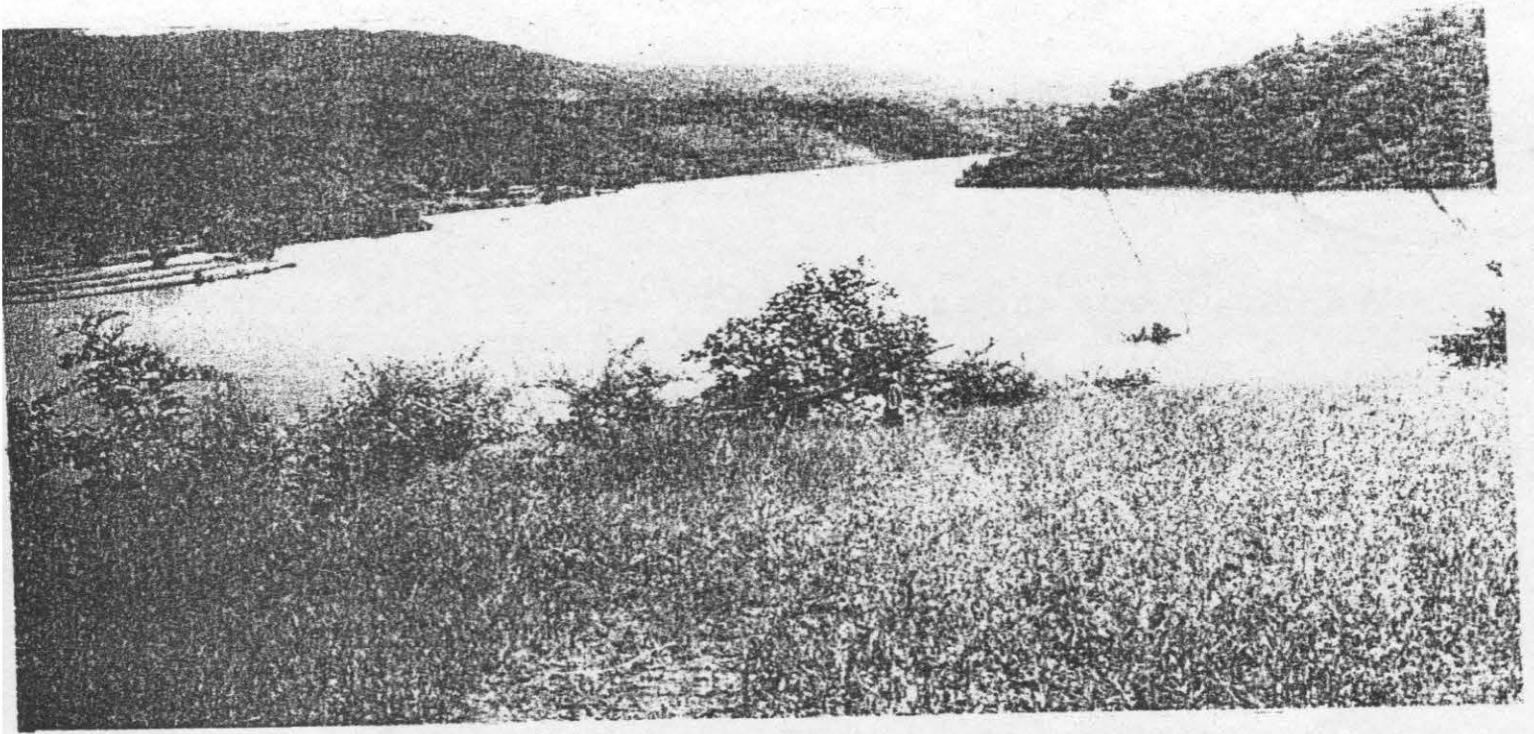
5. Soil Erosion in Zone I

zone experiences an average annual rainfall ranging between 3000 mm to 4500 mm.s. The vegetation is mostly deciduous except in sacred groves where the vegetation is broad leaved valley or ravine type. The third zone extends upto Mangaon and Gondekhal on the southern and northern banks respectively. The fourth zone is situated further towards the west and ends at the crestline of the western ghats near Dapsare. The annual rainfall is above 7500 mm.s. The vegetation is mostly semi-evergreen type. The distribution of the 24 villages in the Panshet catchment area according to zone is given in Table 2.6. (See also Map 6)

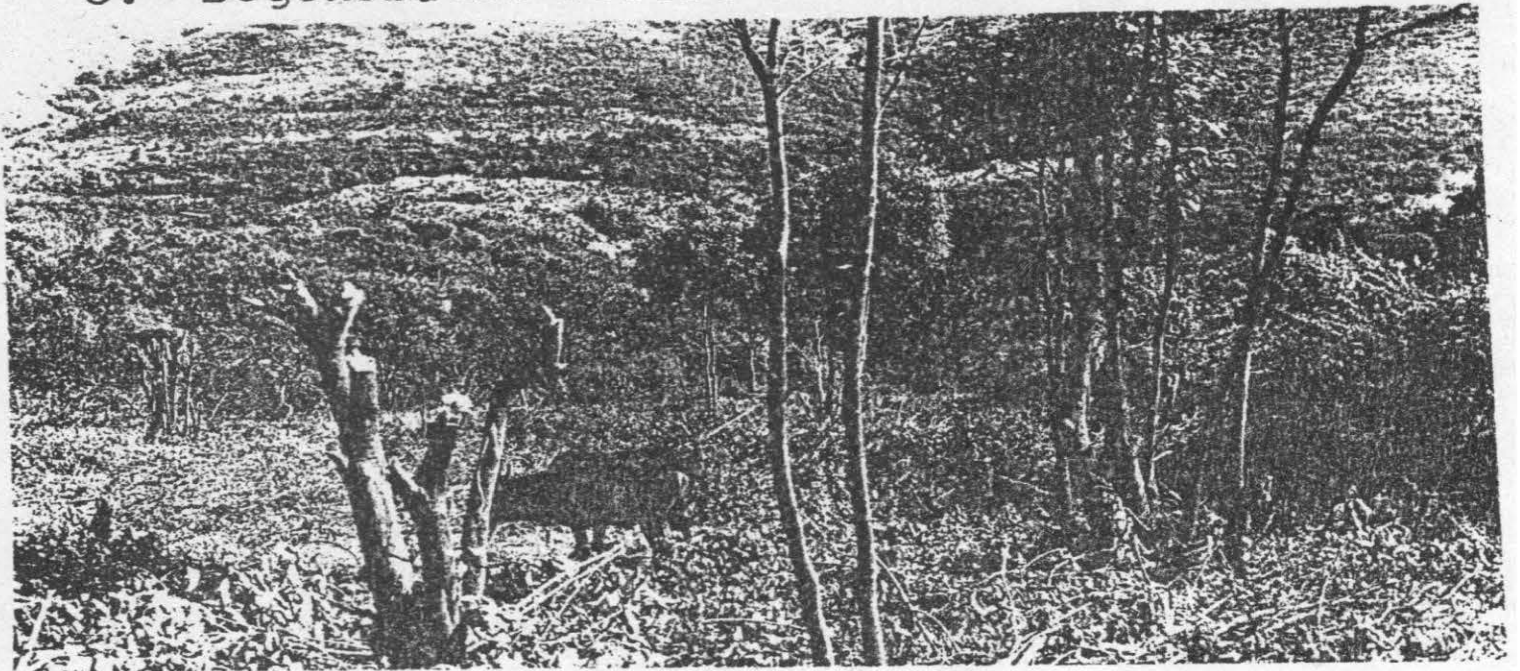
Table 2.5: Temperature of Water, Humidity and Average Wind Velocity at Panshet

Month	Temperature of water (C°)	Humidity %	Average wind velocity (km/hr)	Simulative reading depth of evaporation in mm. water depth
1982:				
November	24°-27.5°	53-70	3.20	88.90 - 252.50
December	20°-29°	60-64	4.35	252.50 - 417.50
1983:				
January	16°-22°	49-65	2.95	417.50 - 559.90
February	15°-20°	45-58	2.93	559.90 - 718.80
March	14°-23°	42-54	4.94	718.80 - 908.30
April	19°-27°	38-49	6.91	908.30 - 1205.50
May	21°-28°	37-48	7.47	1205.50 - 1500.20
June	25°-30°	42-50	7.05	1500.20 - 1834.50
July	23°-30°	53-71	9.00	1834.50 - 2074.74
August	22°-27°	70-78	11.21	2074.44 - 2284.24
September	22°-27°	72-78	13.42	2284.24 - 2757.34
October	22°-25°	72-75	6.88	2757.34 - 2883.34

Source: Irrigation Department, Panshet.



6. Degenerated Forest in Zone IV



7. Felling of Vegetation for Shifting Cultivation in Zone IV.



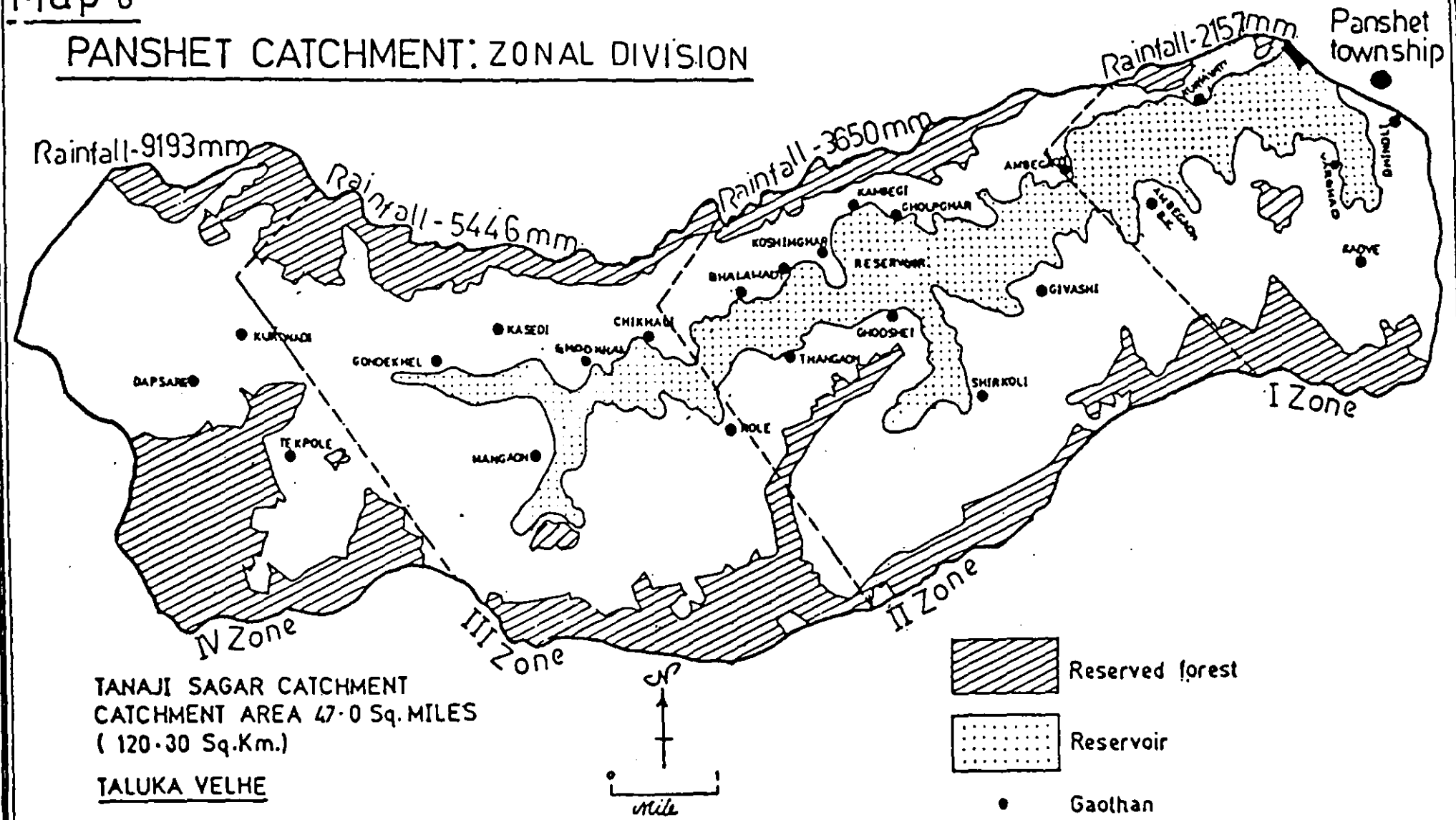
8. Erythrina variegata and Euphorbia nivula in Zone IV

Table 2.6: Distribution of the Villages from the Panshet Reservoir Catchment Area by Zones

	Village with rain-gauge	Average annual rainfall (mm)	Name of the villages in the zone
Zone I	Panshet	2157	Panshet, Kuravati, Kadve, Dhindli, Vadghar, Ambegaon Budruk, Ambegaon Khurd.
Zone II	Shirkoli	3630	Gholapghar, Kambegi, Bhalawadi, Koshimghar, Shirkoli, Givashi, Ghodshet, Thangaon
Zone III	Mangaon	5446	Chikali Khurd, Gondekhal, Kasedi, Ghodkhal, Mangaon, Pole
Zone IV	Dapsare	9194	Tekpole, Kurtawadi, Dapsare

Map 6

PANSHET CATCHMENT: ZONAL DIVISION



CHAPTER III

The Flora of Panshet Catchment

1. Forests of Pune District:

The rough outline of the forests of Pune District resembles that of a boot, with the toe turned towards the east and formed by the junction of the two rivers, the Bhima and the Nira. The back of the boot is formed by the Western Ghats. The crest of the Western Ghats forms the northern and western boundary of Pune forests. These hill ranges run parallel to the sea-coast, with a general elevation of about 600 metres though occasionally hills rise to the height of 1300 metres or more above the sea level. An elevated plateau interspersed with numerous hills occur behind these Ghats. The ridge of the Western Ghats has an immense effect on the climate of the district, since there is a heavy precipitation on the ridge itself with a very marked rainshadow east of it. The rapid changes in the rainfall over such a short distance have direct effect on the vegetation since a large portion of the area becomes a succession of tension zones where no vegetational formations can find optimum conditions, hence cannot occupy a large distance. Such a fascinating environment has produced a variety of vegetation patterns with a variety of plants adapting to different localities. The steep western slopes which are inaccessible have retained the forests. Hacking and grazing were limited, limited to such an extent as to just fulfill the family requirements, while the eastern hill

slopes which were fairly accessible, suffered steady depra-dations - decades of commercial exploitation of the forests coupled with hacking and grazing have reduced the greater part of the area to a stage where trees have given place to shrubs and grasses.

Vegetation in any area is dominated by a few plant species; the others are secondary. In fact, the dominance of some specialized plant species is largely controlled by the environmental conditions. Vegetation indicates the ability of various species to cope up with the climatic conditions and the seasonal changes therein. Vegetation readily responds to the changes in the habitat. If the habitat changes, certain species and, often whole groups of plants disappear and are replaced by others. In the adjustment to a modified environment, the entire composition and structure of the vegetation may be altered. Such changes are not only of much scientific interest but are also frequently of great economic importance.

2. Floristic Studies:

Pune district has attracted the attention of botanists from the 19th century. But the early studies were mere plant collections, limited to the fairly accessible hill resorts in the Sahyadri ranges. A good deal of information was given in the Bombay flora by Dalzell and Gibson (1861). The study sites include Lonavala and Khandala. This study was followed

by a series of plant collections by Arjun, Nimmo, Birdwood and Kirtikar. However, in the later years various authors felt the need to explore the hill forts and other places in the eastern part of the district. Phadnis (1929), studied the Chatushringi hill in Pune and reported that Boswellia should be regarded as a pioneer in the woodlands of this hill. A pioneering work on ecology was carried out by Garland (1932), who described six stages of succession in the Deccan trap tract. The report for the first time expressed a concern about the increasing biotic pressure and its effects on vegetation. In recent years Razi (1952), Jain & Puri (1957 a, b), Puri & Patil (1957 a, b & c) and Chandras & Kulkarni (1970) have studied the vegetation patterns in the eastern part of the Pune district. But even in the later years botanical explorations and vegetation studies were not carried out in many parts of the western hill ranges in the Pune district. Soon after independence, multipurpose river valley projects and other dams came to be regarded as essential for irrigation, and power generation. The steep western slopes with its characteristic high precipitation were considered to be ideal locations to construct the dams. Such irrigation works include Panshet, Warasgaon and Pawana dams. An altogether different concern, a big threat to the people, plants and wildlife due to the construction of a dam was reported by Gadgil & Vartak (1973, 76) and Gole & Tetali (1985) who

emphasized the need to protect the fragile ecosystems in the catchment areas with a special emphasis on the Panshet dam catchment area.

3. Past Vegetation:

There is no clear information available about the occurrence of the past flora of the Pune district, that could be compared with the present-day vegetation. However to get some idea about the changes in the vegetation in the Pune district, the information available in the Bombay Gazetteer (1885) is used. It must be noted that the term 'found', used often in the Gazetteer to denote the distribution of plants is rather vague. Keeping the limitations in view, the common plant species with its occurrence given in the Bombay Gazetteer are compared with the current position in the Panshet catchment area studied through a systematic survey in 1984-85. (See Table 3.1)

There appear some changes in the vegetation if the flora of the Poona district, prepared by Wallinger, is compared with the present-day vegetation. Certain trees such as Gmelina arborea, Lagerstroemia parviflora, Pongamia pinnata which are mentioned in the Poona district Gazetteer either as plentiful or abundant on the western hills of the Pune district are only occasionally or rarely seen in the Panshet dam catchment area. These trees have got a good timber or

Table 3: Occurrence of important plant species in the past and at present on Western hills of Poona district.

Botanical name	Past		Present				
	PG	R	SG	IZ	IIZ	III Z	IVZ
<u>Acacia nilotica</u>	C	-	N	O	R	N	N
<u>Actinodaphne angustifolia</u>	-	-	A	N	VC	C	VC
<u>Aegle marmelos</u>	C	-	N	N	N	N	N
<u>Albizzia lebbek</u>	FO	-	R	N	N	N	N
<u>Allophylus serratus</u>	-	-	C	R	C	C	C
<u>Alstonia scholaris</u>	-	-	O	N	N	R	N
<u>Anogeissus latifolia</u>	C	-	N	R	R	R	R
<u>Annona squamosa</u>	C	-	N	R	N	N	N
<u>Anthocephalus cadamba</u>	-	-	O	N	R	O	R
<u>Argemone mexicana</u>	FO	-	N	N	N	N	N
<u>Artocarpus heterophyllus</u>	O	-	N	N	N	N	N
<u>Asparagus racemosus</u>	-	VC	R	O	R	R	R
<u>Atalantia monophylla</u>	A	-	N	N	N	N	N
<u>Atalantia racemosa</u>	-	-	C	N	R	O	O

Botanical name	PG	R	SG	IZ	II Z	III Z	IV Z
<u>Bauhinia racemosa</u>	P	-	C	O	C	R	R
<u>Bombax ceiba</u>	C	-	N	O	R	N	N
<u>Bridelia squamosa</u>	C	-	C	O	VC	R	N
<u>Buchanania lanzan</u>	FO	-	N	N	N	N	N
<u>Butea monosperma</u>	C	-	N	N	O	FR	O
<u>Calotropis gigantea</u>	FO	-	N	R	R	N	N
<u>Calotropis procera</u>	P	-	N	R	R	N	N
<u>Carissa congesta</u>	FO	VC	C	FR	FR	FR	VC
<u>Caryota urens</u>	-	-	C	N	N	N	R
<u>Cassia fistula</u>	C	-	N	R	R	N	N
<u>Casearia graveolens</u>	-	-	C	N	O	C	O
<u>Cordia dichotoma</u>	C	N	N	N	R	R	R
<u>Crotalaria retusa</u>	-	VC	R	R	C	C	O
<u>Diospyros melanoxylon</u>	FO	-	N	N	N	N	N

Botanical name	PG	R	SG	IZ	IZ	IZ	IVZ
<u>Diploclasia glaucescens</u>	—	—	FR	N	N	R	R
<u>Dysophylla stellata</u>	—	VC	N	N	N	N	N
<u>Dysoxylum binectariferum</u>	—	—	F	N	N	N	R
<u>Elaeagnus conferta</u>	C	—	R	N	N	R	R
<u>Embllica officinalis</u>	FO	—	N	R	C	C	R
<u>Erythrina variegata</u>	P	—	N	N	R	R	R
<u>Ficus arnottiana</u>	—	—	C	N	O	R	R
<u>Ficus glomerata</u>	C	—	R	R	R	R	R
<u>Ficus religiosa</u>	FO	—	N	N	N	N	N
<u>Ficus retusa</u>	—	—	R	R	R	R	N
<u>Flacourtia latifolia</u>	—	—	O	R	R	R	R
<u>Girardinia zeylanica</u>	—	VC	R	N	R	N	N
<u>Gmelina arborea</u>	A	—	N	R	R	N	N
<u>Grewia tiliacifolia</u>	C	—	N	R	R	R	R
<u>Hiptage madablota</u>	—	VC	A	N	O	C	C

Botanical name	PG	R	SG	IZ	II Z	III Z	IV Z
<u>Lagerstroemia lanceolata</u>	A	—	F	N	R	R	N
<u>Lagerstroemia parviflora</u>	A	—	F	N	N	R	N
<u>Lantana camara</u>	—	—	O	A	A	O	O
<u>Lasiosiphon eriocephalus</u>	—	VC	C	F	VC	C	VC
<u>Macaranga peltata</u>	—	—	C	N	N	R	C
<u>Madhuca indica</u>	FO	—	R	N	N	N	N
<u>Mangifera indica</u>	FO	—	C	R	N	N	R
<u>Melia composita</u>	—	—	N	R	N	N	N
<u>Meynaa laxiflora</u>	FO	—	R	O	C	C	O
<u>Memecylon umbellatum</u>	P	—	F	N	N	C	VC
<u>Murraya koenigii</u>	—	—	C	N	N	R	R
<u>Olea dioica</u>	—	—	A	N	N	R	R
<u>Phoenix sylvestris</u>	PL	—	N	N	N	N	N
<u>Pongamia pinnata</u>	P	—	N	N	N	R	R

Botanical name	PG	R	SG	IZ	IIZ	III Z	IV Z
<u>Santalum album</u>	O	—	N	N	N	N	N
<u>Semecarpus anacardium</u>	C	—	N	N	N	N	N
<u>Smithia hirsuta</u>	—	VC	N	FR	FR	FR	FR
<u>Sterculia foetida</u>	—	—	N	N	N	N	N
<u>Sterculia guttata</u>	—	—	R	N	N	N	R
<u>Symplocos racemosa</u>	FO	—	N	N	N	N	N
<u>Syzygium cumini</u>	VC	VC	F	R	O	C	C
<u>Tamarindus indica</u>	CU	—	N	R	N	N	N
<u>Terminalia alata</u>	C	—	R	A	F	O	R
<u>Terminalia bellerica</u>	—	—	O	R	O	C	O
<u>Terminalia chebula</u>	P	—	R	R	O	C	O
<u>Tragia involucrata</u>	—	C	O	N	R	R	R
<u>Wrightia tinctoria</u>	—	—	F	N	N	C	C
<u>Xeromphis spinosa</u>	P	—	F	N	C	VC	C
<u>Xylia dolabriformis</u>	—	—	F	N	N	N	N
<u>Zizyphus rugosa</u>	C	—	N	V	C	C	C

Abbreviations Used in Table 3.1Past Vegetation:

P.G. - Poona District Gazetteer (1885)

Fo - Found

O - Occasional

C - Plentiful

A - Abundant

- - Not mentioned

R - Razi - Some Aspects of Vegetation in Poona
and its surrounding districts (1952)

Present Vegetation:

S.G. - Sacred Grove

IZ - Forest area from Ist Zone

IIZ - Forest area from IInd Zone

IIIZ - Forest area from IIIrd Zone

IVZ - Forest area from IVth Zone

R - Rare

O - Occasional - 0-20% frequency

C - Common - 21-40% frequency

Vc - Very common - 41-60% frequency

Fr - Frequent - 61-80% frequency

A - Abundant - 81-100% frequency

Cu - Cultivated

N - Not seen

fuel value. Perhaps due to this reason these trees have been cut down on a large scale. Certain exotic species such as Lantana camara, and Argemone mexicana which are not mentioned in the Poona District Gazetteer have taken over large forest tracts especially in the first and second zones of the catchment area. The exposed hill slopes, with shallow soil depth can hold no vegetation, but these weeds which can grow even in much degraded conditions. This indicates a state of depredation, a stage between grass-land and thorny forest in the succession. Certain evergreen species like Syzygium cumini and Memecylon umbellatum, are still very common in the inaccessible forest patches of the third and fourth zones of the Panshet catchment area. Some tree species like Xylia dolabriformis and Dysoxylum binectariferum, which are totally absent in the forest lands are frequently found in the Mangaon sacred grove. These trees have not been mentioned in the Poona District Gazetteer. Both these species are shade loving, flourish well in preserved plots, when biotic interference is minimal. Their presence is an indication of natural forest.

4. Methods:

To make a systematic study of the vegetation in the Panshet catchment area, one village was selected from each of the four zones and studied by quadrat method. Quadrat is a square area of varying size marked off for the purpose of

plant enumeration. The quadrat study is employed in counting the individual plants of each species to determine their frequency, density and abundance as given by Misra (1968). One metre quadrat was employed to find out the composition of the grass-lands, while 10 metre quadrats were employed for trees, shrubs and climbers. The number of quadrats taken in each zone also varied. Quadrat of 10 metres size was employed as the fallows are odd shaped and often small. The average fallow period of each village was calculated and quadrats were taken according to the average fallow period.

Plant distribution in a community is not uniform. The plant communities are influenced by environmental characteristics and biotic factors. Frequency indicates dispersion of a species in a community. Frequency is estimated in percentage and is estimated as under:

$$\text{Frequency} = \frac{\text{Number of quadrats in which species occurred}}{\text{Total number of quadrats studied}} \times 100.$$

Raunkaier (1934) classified the species in a community into five frequency classes as under.

Class A	-	Species with frequency from	1	-	20%
Class B	-	" " " "	21	-	40%
Class C	-	" " " "	41	-	60%
Class D	-	" " " "	61	-	80%
Class E	-	" " " "	81	-	100%

Raunkaier's frequency diagrams are prepared from the calculated frequency data.

Density: Indicates the numerical strength of plants in a community and the number of plant species per unit area; it is calculated by using the following formula:

$$\text{Density} = \frac{\text{Total number of plants in the quadrats}}{\text{Number of quadrats examined}}$$

Abundance is again the numerical strength of plant species in the total number of quadrats in which it occurs. Abundance is calculated by using the following formula:

$$\text{Abundance} = \frac{\text{Total number of plants of a species in all the quadrats}}{\text{Number of quadrats in which the species occurred}}$$

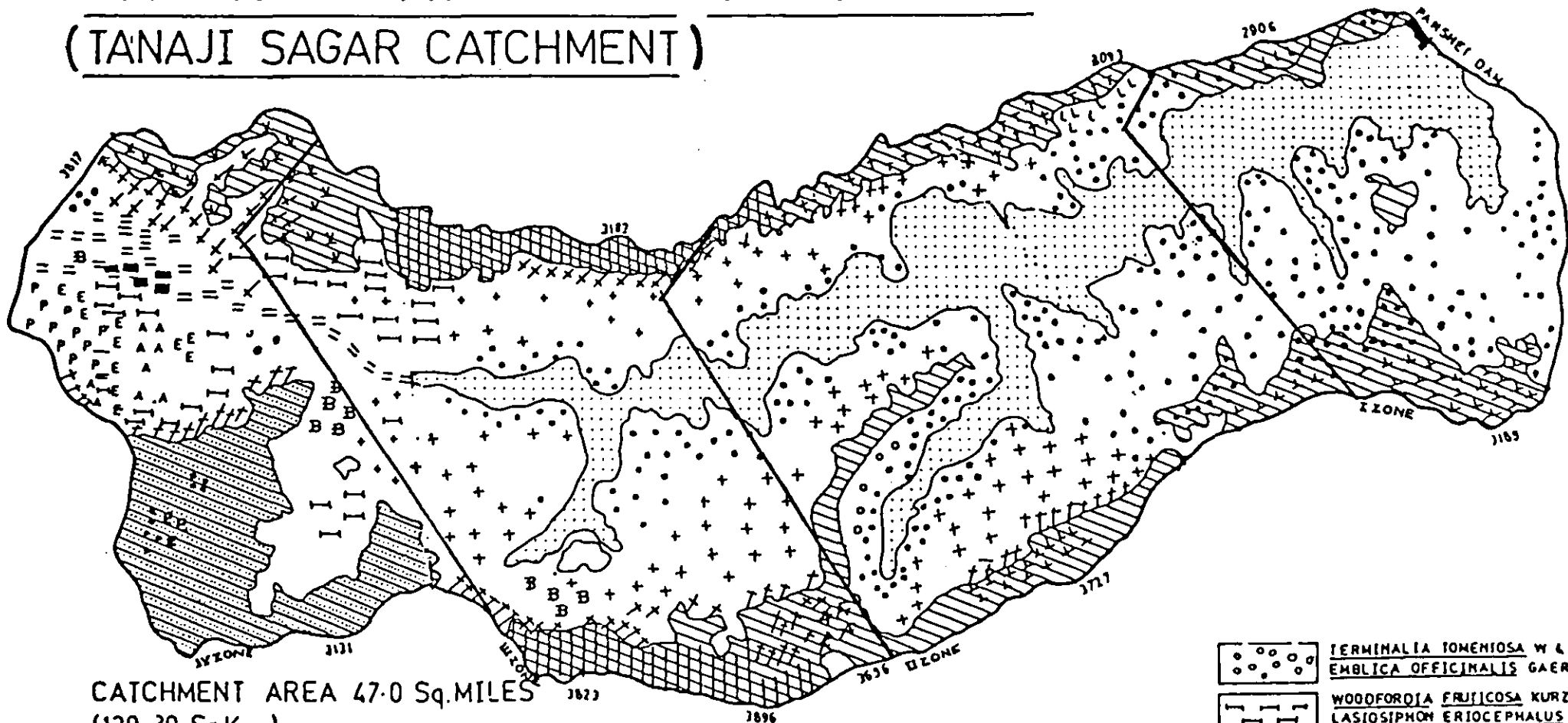
5. Present-day-vegetation:

The vegetation of Panshet catchment can be broadly divided into four groups. They are: (a) Grass-lands, (b) Tropical moist-deciduous forest, (c) Tropical semi-evergreen forest and (d) Broadleaved valley or ravine forests. (Map 7)



The plants are either widespread and occur in all the zones or they may be restricted to a narrow area of tension belts depending upon the action of various factors. The vegetation changes from grass-land in the first zone to moist deciduous type in the second zone and finally semi-evergreen type of vegetation is seen in the third and fourth zones, with


PANSHET CATCHMENT: VEGETATION


(TANAJI SAGAR CATCHMENT)




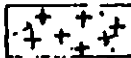
CATCHMENT AREA 47.0 Sq.MILES
(120.30 Sq.Km.)
TALUKA VELHE DIST: PUNE

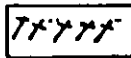
 RESERVED FOREST
 RESERVIOR


 METEROPOGON CONIURIUS P. BEAUV
THEMEDA QUADRIVALVIS O. KIZE

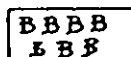
 LANTANA CAMARA L


 TERMINALIA TOMENTOSA W & A


 LANTANA CAMARA L-CARISSA CONGESTA WIGHT


 STROBILANTHES CALLOSUS NEES


 BRIDELIA SQUAMOSA GEHRM
TERMINALIA TOMENTOSA W & A


 BUTEA MONOSPERMA TAUB
XEROPHIS SPINOSA KEAY

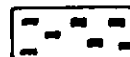
 TERMINALIA TOMENTOSA W & A-
EMBLICA OFFICINALIS GAERT

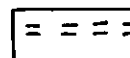
 WOODFORDIA FRUTICOSA KURZ
LASIOSIPHON ERIOCEPHALUS DCME

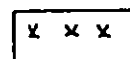
 ERYTHRINA VARIEGATA HERR
EUPHORBIA HERRIFOLIA ROHM

 PHOENIX HUMILIS BECC
DENDROCALAMUS STRICTUS NEES

 SYZYGIUM CUMINI SKEELS
WENDLANDIA IMYRTOIDEA S
MACARANGA PELIATA MUELLA
MEMECYLON UMBELLATUM
BURN-FICUS Sp

 MANGIFERA INDICA MEMECYLON
UMBELLATUM BURN SYZYGIUM
CUMINI SKEELS, FICUS

 DENDROCALAMUS STRICTUS NEES
SYZYGIUM CUMINI SKEES
STROBILANTHES Sp

 ACTINODAPHNE HOOKERI WEISSM
GLOCHIDIUM MOHENAICKERI
BEDD

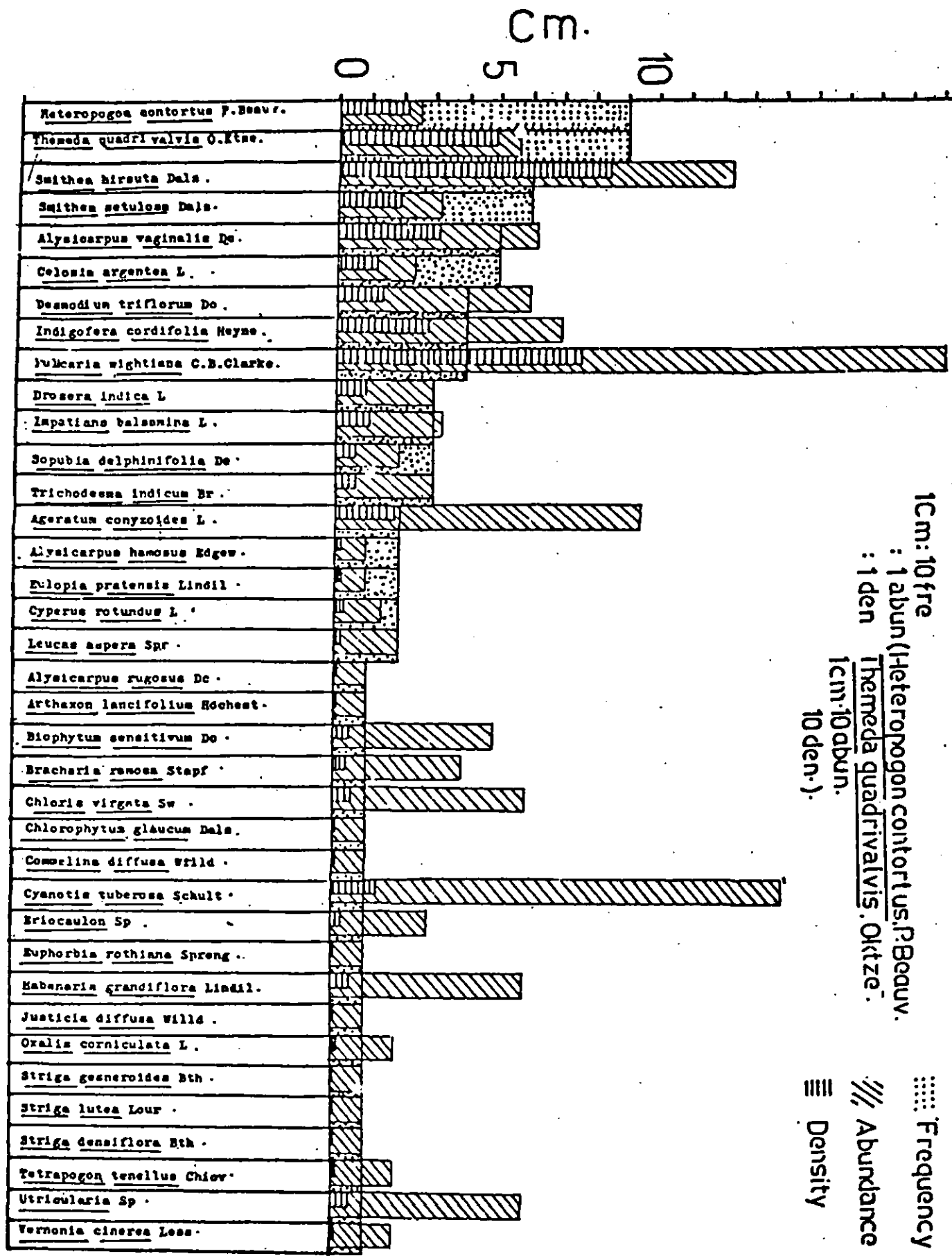
the increase in the rainfall towards the crest side. Though there is no clear demarcation, there is a great change in the type of vegetation from the dam site to the crest line. Besides these, Vartak (1966) placed the vegetation of sacred groves under the broad leaved valley or ravine vegetation. The remarkable feature of the catchment area is the sudden change of hill slopes from black colour to green with the onset of monsoon, which entirely changes the floristic composition of the otherwise barren hill slopes. Annuals flourish with the monsoon rains; conditions are favourable for their growth from June to November.

On the lower part of the hills of the first zone only a few large trees are seen. Among these can be mentioned, Terminalia alata, Ficus bengalensis, Mangifera indica. In the grass-land Themeda quadrivalvis, and Heteropogon contortus are abundant. Annuals like Smithia hirsuta, Smithia setulosa, Celosia argentea, Alysicarpus vaginalis, and Senecio edgeworthii, are commonly seen. However, Chlorophytum tuberosum and Habenaria grandifloriformis disappear within two weeks of the onset of monsoon. In the fallows the vegetation is dominated by Lantana camara; next comes the dominant tree Terminalia alata. Some other shrubs that frequently occur are Carissa congesta, Lasiosiphon eriocephalus and Zizyphus rugosa. In the forest area Terminalia alata and Lantana camara occur almost with

equal frequency. The tree canopy is dominated by Terminalia alata, the lower canopy is dominated by Lantana camara. (See figs. 3.1, 3.2 and 3.3) In the places where inroads are made, specially by the road cuttings Artemisia parviflora is the first plant to occupy in the early successional stages. While on the table lands of Kadve Cippadessa is a very common shrub. During January-February Argemone mexicana and Dysophylla stellata frequently occur in the rice fields of Kadve village.

The second zone acts as a buffer zone which is dominated by deciduous trees with occasional evergreen trees. There is a considerable decrease in the frequency of Lantana camara in this zone, where many wild plants are equally competing with it. The number of plants also increases in both the fallow lands and reserved forests. 7-10 years of fallow period is maintained in the private lands. In the lands left fallow for about 5 years Lantana camara and Carissa congesta are frequent, while other plants like Zizyphus rugosa, Woodfordia fruticosa, Meynea laxiflora, Lasiosiphon eriocephalus, Embelia tsjeriam-cottam are very common. The common trees are Terminalia alata, Syzygium cumini and Emblica officinalis. In the reserved forest the lower canopy is mainly dominated by Carvia callosa and Lantana camara. The common trees are Terminalia alata, Actinodaphne angustifolia and occasionally Bridelia squamosa. (See figs. 3.4 and 3.5)

20 Fig-3-1



I ZONE GRASS LAND

1cm: 10ftre
 : 1 abun (Heteropogon contortus, P.Beauv.
 : 1 den Themeda quadrivalvis, Oltze.
 1cm: 10 abun.
 10 den.)
 Frequency
 /// Abundance
 ||| Density

Fig. 32 I ZONE RESERVED FOREST

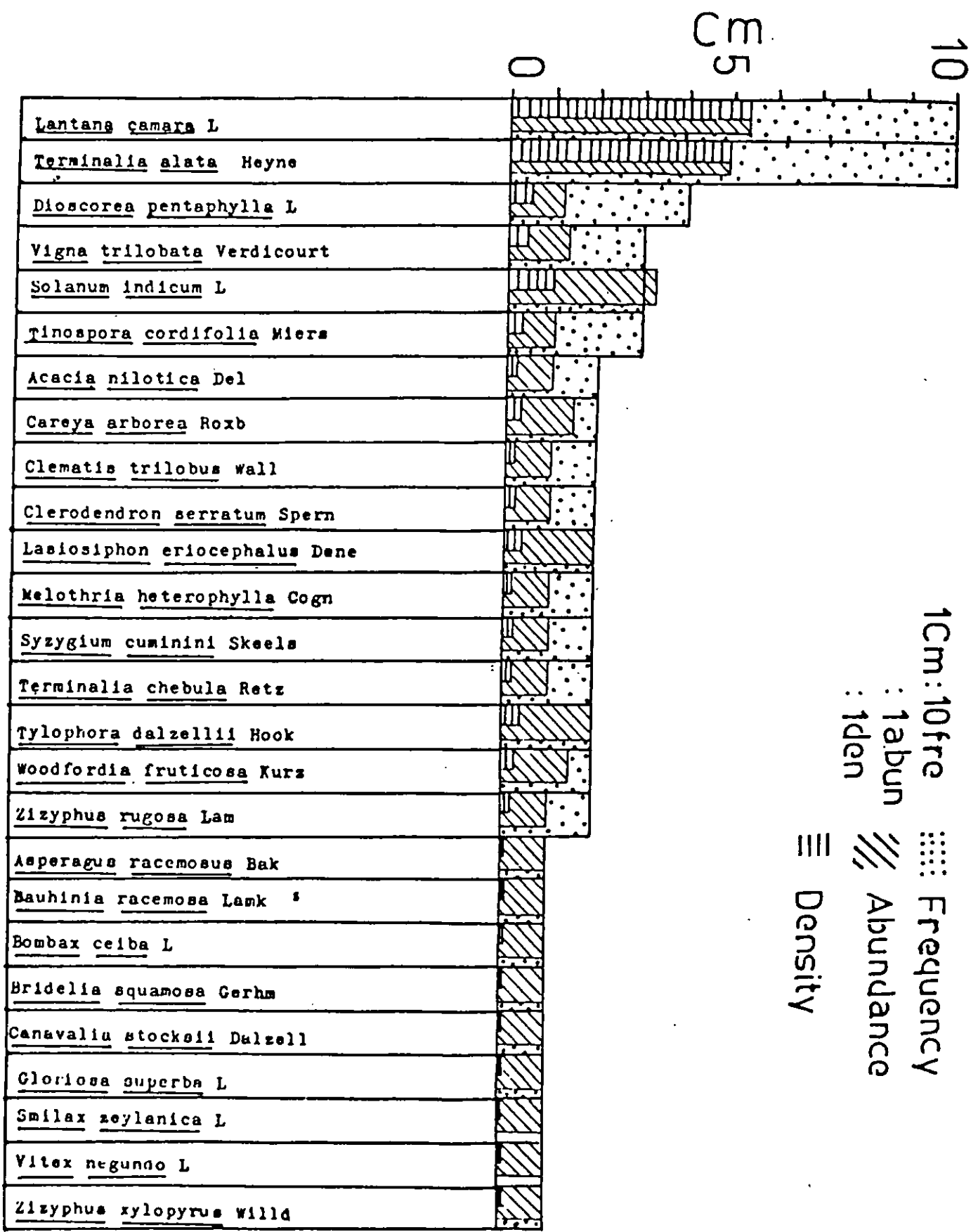


Fig. 33

I ZONE FALLOW

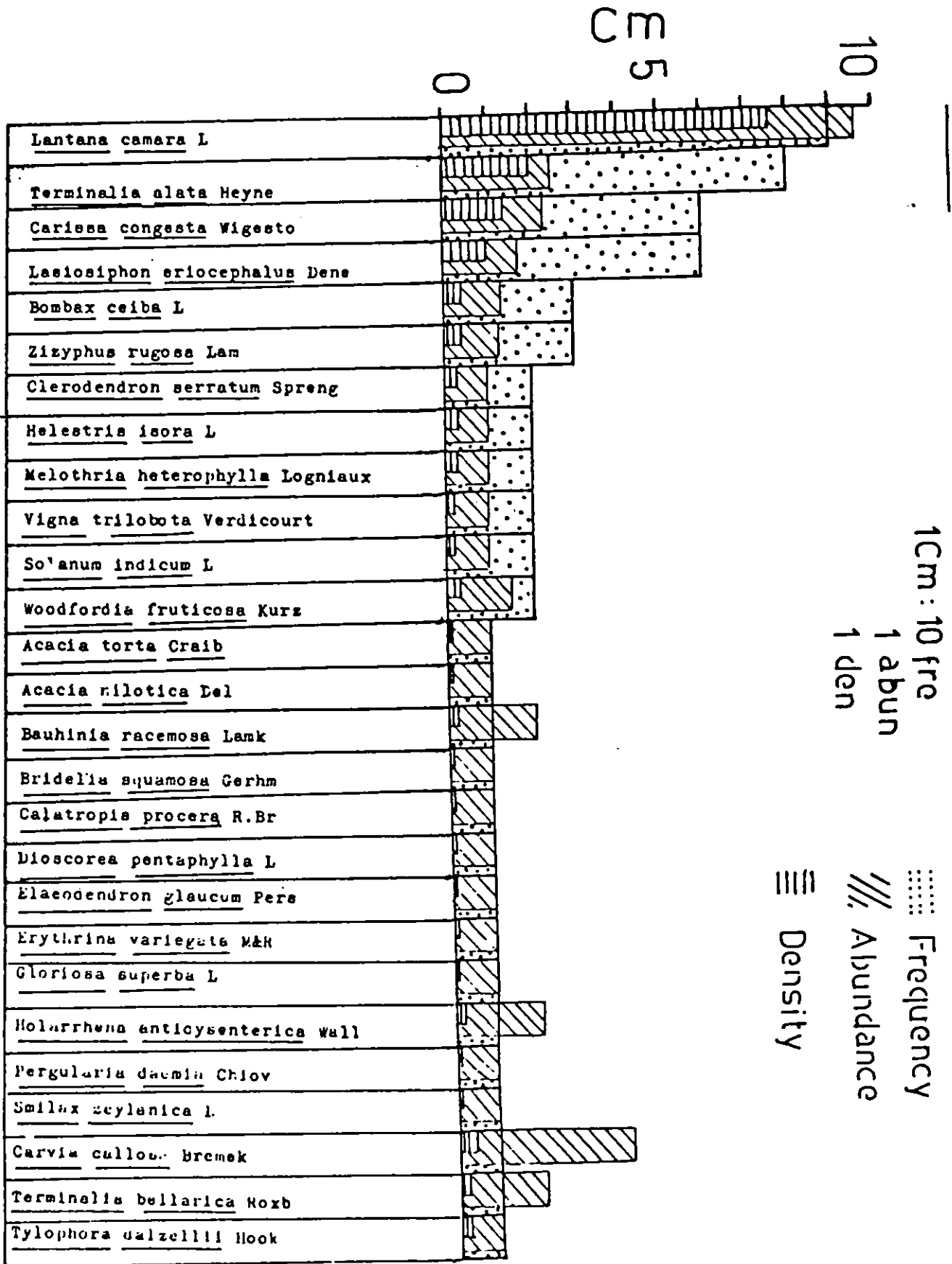


Fig. 34

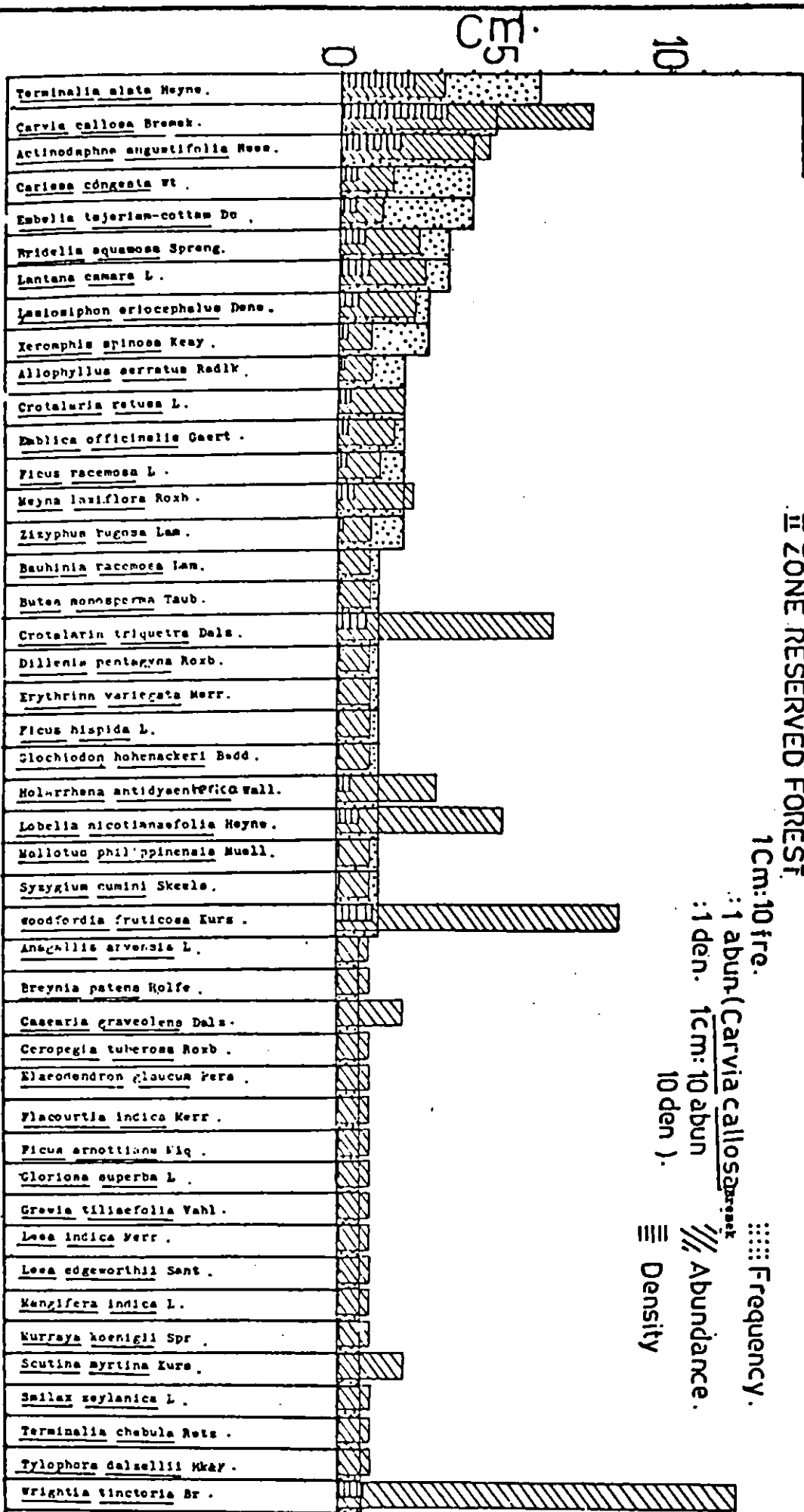
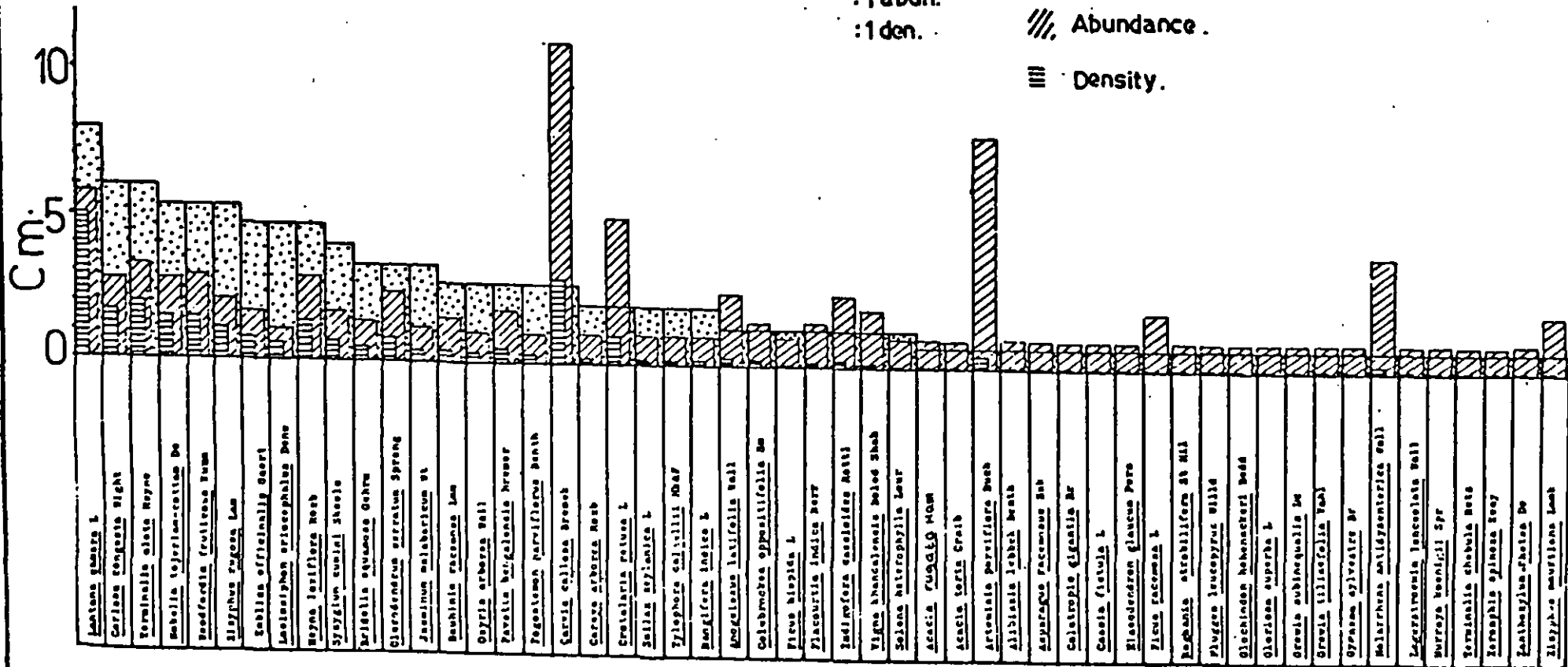


Fig. 35

II ZONE FALLOWS

1Cm:10 fre. Frequency.
 :1 abun. Abundance.
 :1 den. Density.



The third zone shows no marked differences with the second zone except for the village Mangaon, where the vegetation is unique. Forest area is much denuded except for the sacred groves. Butea monosperma is abundant in the fallows. Some other plants like Meynea laxiflora, Carissa congesta, Randia dumetorum, Woodfordia fruticosa and Jasminum malabaricum are very common. Lantana camara and Terminalia alata are occasionally seen. (See fig. 3.6)

The fourth zone, which is almost at the crest of the Western Ghats is unique and complex. Vegetation changes from place to place. Here the effects of topography and soil depth are clearly visible. Many plants are growing competing to dominate a limited space. Erythrina variegata and Euphorbia nivula are abundant on the barren rocks. While on flat tops, where the soil depth is just a few mm., Ficus glomerata, F. arnottiana, and Memecylon umbellatum are abundant. On the steep slopes trees are totally absent. Carvia callosa, Wrightia tinctoria and Casearia graveolens are frequent. At the lower table lands where soil depth is a few centimetres Glochidion hohenackeri, Actinodaphne angustifolia, Xylia dolabriformis, Macaranga peltata are very common. The lower canopy is dominated by Embelia tsjeriam-cottam, Murraya koenigii; Allophyllus serratus, Atalantia racemosa; Leea indica and Ixora sp. (See fig. 3.7)

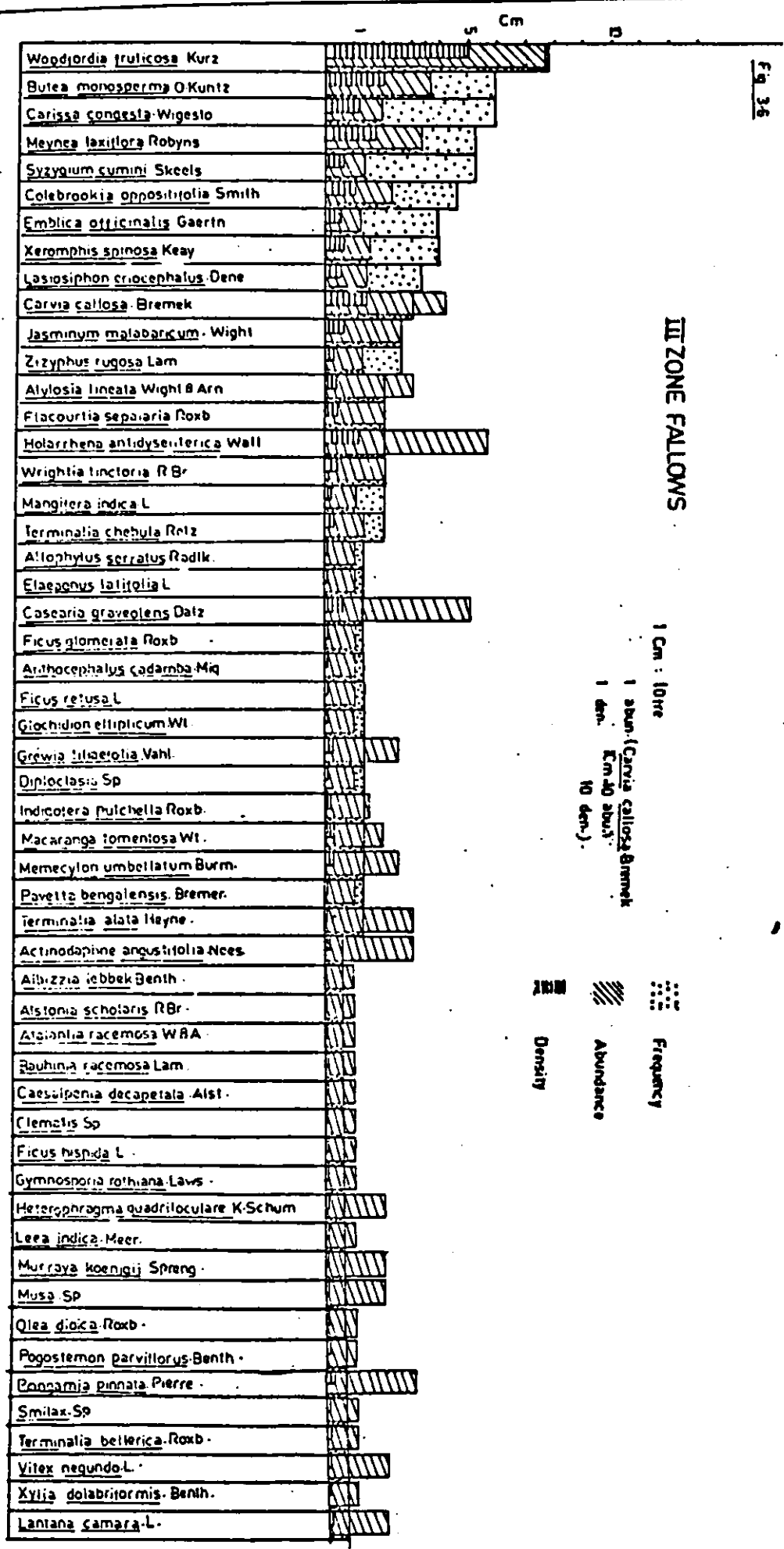
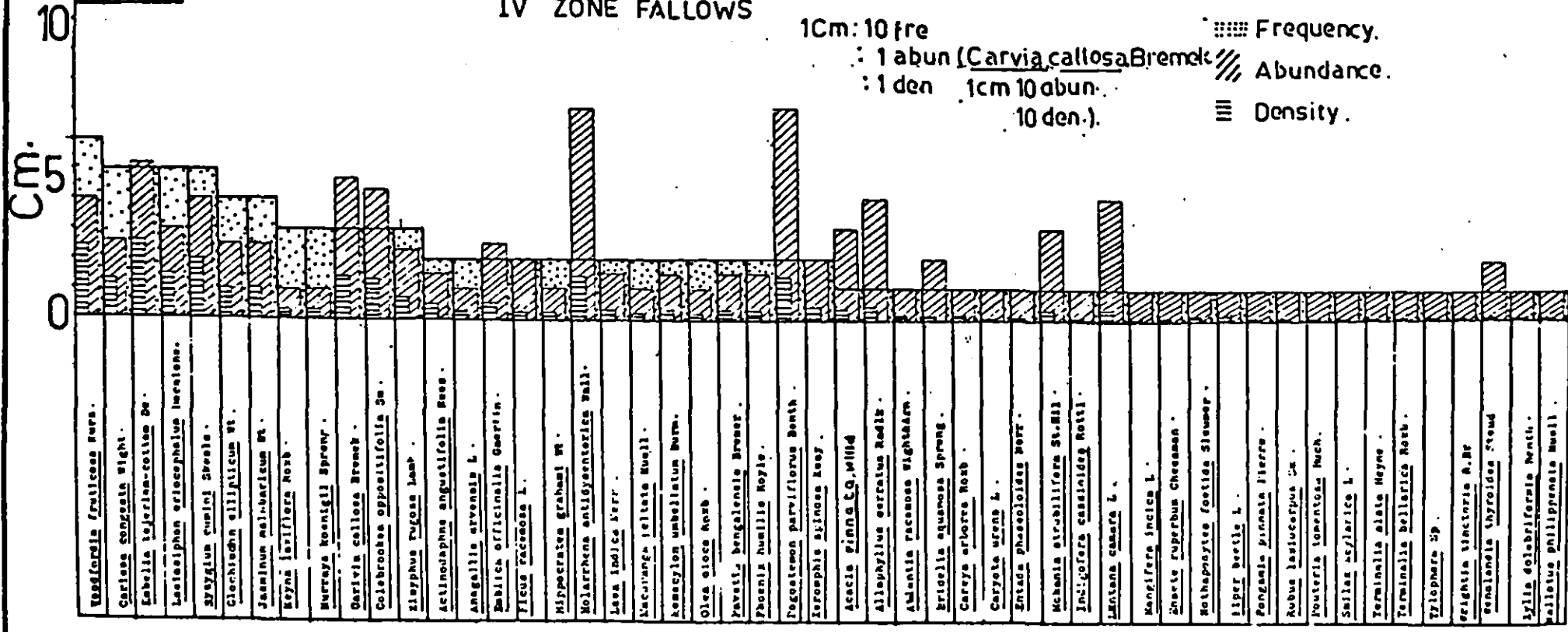


Fig. 37

IV ZONE FALLOWS



The vegetation along the streams of the third and fourth zones shows considerable changes. Perhaps these are the only places, other than the sacred groves where tall trees are seen. The common trees along the streams are Mangifera indica, Ficus glomerata; F. arnottiana, Pongamia pinnata; Alstonia scholaris, Memecylon umbellatum, Syzygium cumini and Sterculia foetida. The lower canopy is dominated by plants like Acacia concinna and Homonoia riparia.

Vegetation in general is sparse. Trees are short and stunted; they do not form a close forest anywhere except in the sacred groves. Due to the continuous human interference for the last three decades whether it is for timber or charcoal, for fuel or raab or grass for cattle, whatever may be the reason the intensity of necessities and selection of species have a tremendous impact on changes in the vegetational patterns and finally on the soil. The resultant vegetation due to increasing biotic pressure forms a series of sub-climax successional stages in each zone with changing edaphic and physical factors.

The stress upon many plants is mostly anthropogenic, which results in the reduction in the number and diversity of plant species. For example, when the vegetation is cut on a large scale or burnt, many shade loving plants vanish, and fire tolerant varieties are spreading menacingly. Such sensitive plants are surviving now only in the sacred groves. The

commonly occurring plants in any of the zones are characteristic thorny unpalatable, or poisonous species. The change of vegetation from zone to zone is mainly because of the changes in the physical environment especially the rainfall.

Raunkiaer's Frequency Diagram: The frequency of different plant groups in forest and fallow lands from different zones is indicated in fig. 3.8. The number of plant species per quadrat increases from Ist zone to IInd zone and from IInd zone to IIIrd zone. The change of species diversity in reserved forest, fallows, and sacred groves are mainly due to the biotic disturbance. While in the reserved forest areas it is also because of latitude change. The diversity and number of plant species increase with the increasing fallow period. A fifteen years fallow exhibits often greater diversity of plant species than the reserved forest area, though unprotected.

The common occurrence of trees like Terminalia alata, Mangifera indica and Bridelia squamosa are the result of human selection. While the spreading of Lantana camara, Carissa congesta, Carvia callosa, like shrubs are mainly due to the biotic pressure. When both cattle and human interference increases grass-lands are conspicuous.

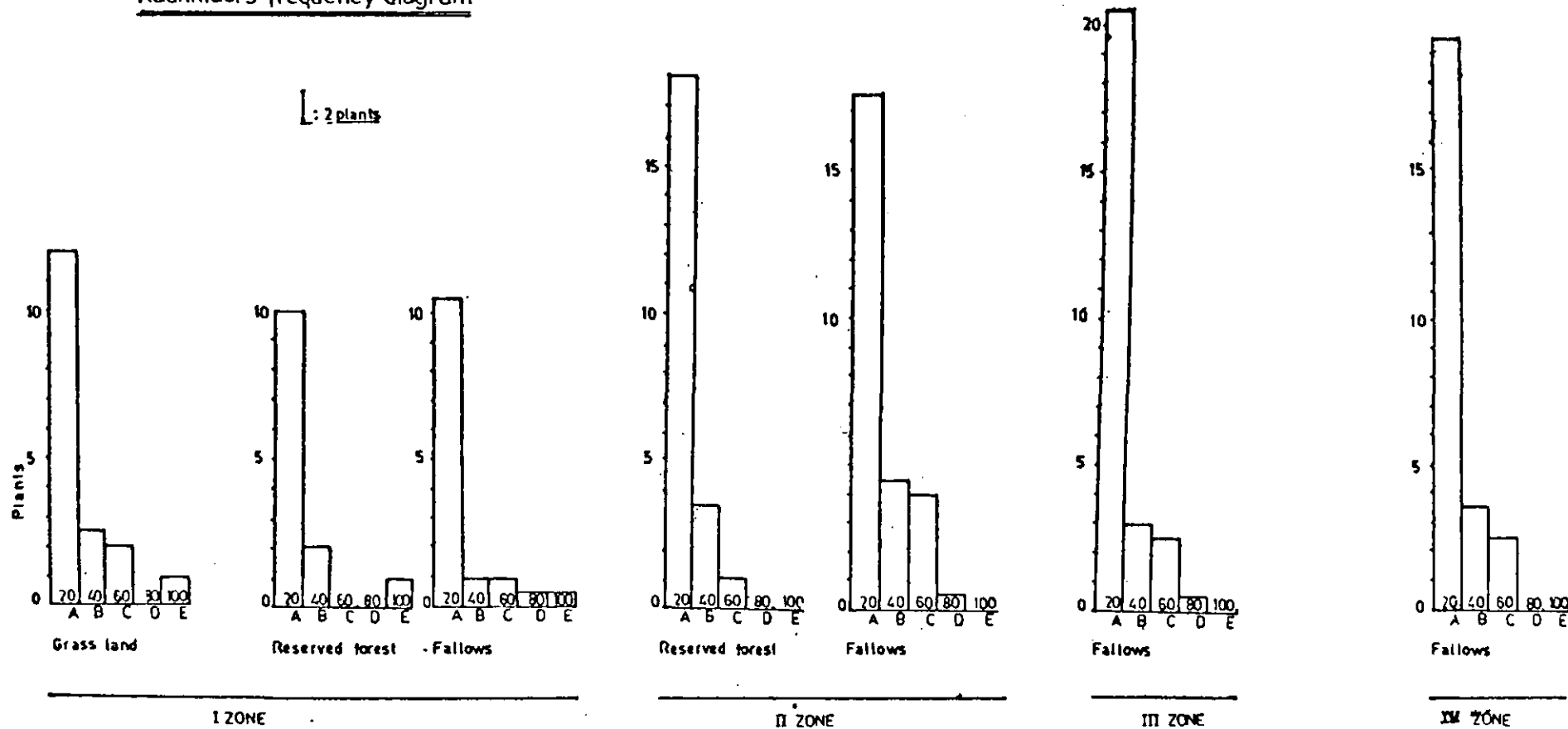
6. Succession:

The nature of succession in the catchment area is as follows: The exposed rock with shallow soils have a tendency to

Fig 38

Raunkiaer's frequency diagram

┌ : 2 plants



carry the species of commelinaceae, Eriocaulon sp. and Oropetium sp. rather than the grasses in the beginning, which give suitable conditions to species like Heteropogon contortus and Themeda quadrivalvis. There is a constant struggle between these two species for supremacy; when protected Themeda quadrivalvis covers large tracts and dominates Heteropogon contortus, which becomes a co-dominant and covers large tracts of land and gives a characteristic appearance to the hill slopes. Heteropogon sp. dominates in the areas where slopes are often subjected to fires. Some principal species in this type of grass-land during the monsoon are Smithia sp. and Alysicarpus sp. But in the third and fourth zones Braken fern and Leucas montana are very common plants during this stage. Natural succession beyond this stage is rare due to severe biotic interference. These conditions are aggravated further and allow the plants like Erythrina variegata, and Euphorbia nivula to grow when shifting cultivation is practiced on the steep upper slopes of the third and fourth zones. Succession beyond this stage follows in four different directions with changing zones. There is a constant struggle for supremacy between wood-land and grass-land. When there is human interference the conditions favour the growth of grass-land. The clearing of forest in many cases results in the usurption of the ground by grasses of such varieties that have a poor grazing value. Fire and grazing frequently have the same effect.

The resultant vegetation is stunted which finally leads to desert conditions.

In the first zone the shallow soils are dominated by Lantana camara and Carissa congesta while in fresh fallows and on road cuttings species of Artemisia is co-dominant with Lantana camara. Some seasonal plants like Rubia cordifolia, Gloriosa superba, Clerodendron serratum are found during this stage. The succession beyond this stage is very slow. Next stage follows only when the farms are moderately protected. Species like Meynea laxiflora, Woodfordia fruticosa, and Lasiosiphon eriocephalus type of vegetation are likely to occupy the region with other plants like Flacourtia sp. and Zizyphus rugosa. This stage may finally provide a suitable habitat to the species like Terminalia alata, Bridelia squamosa and other species of Ficus, Bauhinia, Bombax ceiba, Cassia fistula, Gmelina arborea.

Succession follows more or less the same way till Terminalia - Bridelia stage in the second zone, where the annual average rainfall is 3,500 mm. Species of Ficus and Actinodaphne angustifolia form the final stage which can be noticed on the upper slopes with some common shrubs like Pavetta bengalensis, Xeromphis spinosa, Carvia callosa and trees like Flacourtia indica, Embllica officinalis. But the region is mostly dominated by deciduous trees. Progression beyond this is not seen anywhere due to biotic interference.

The third and fourth zones fall in the very high rainfall areas and experience respectively an annual average of 5,000 mm. and 9,000 mm. Lantana camara is rarely seen as other shrubs are favoured due to different climatic conditions. Woodfordia fruticosa, Lasiosiphon eriocephalus and Carissa congesta are the type of vegetation first to occupy the grasslands and soon dominate the entire region. This may be followed by Meynea and Xeromphis species in the third zone. Some other common plant species in this type are Indigofera cassioides and Colebrookea oppositifolia. These shrubs provide a suitable environment for trees like Butea monosperma and Terminalia chebula and Terminalia bellerica. As conditions become more favourable Syzygium cumini and Memecylon umbellatum will dominate. This can be observed in the Mangaon sacred grove where there is a variety of plant species due to the diversity of habitats.

The fourth zone is a fragile zone in which succession is almost the same as in the third zone in the early stage with Woodfordia - Lasiosiphon - Carissa type. Later these areas will be dominated by Wrightia tinctoria, Glochiodion ellipticum and Casearia graveolens, type with some sub-dominants like Actinodaphne angustifolia and Palms like Caryota urens, Phoenix humilis. Unprotected lands do not get beyond this stage. While partially protected lands are dominated by Syzygium cumini, Memecylon umbellatum and Ficus sp. with other

sub-dominants like Sterculia foetida, Olea dioica, Alstonia scholaris, Nothapodytes foetida and climbers like Enteda phaseoloides, Diploclasia sp. and Acacia rugata. (Chart 3.1)

7. Sacred Groves:

Devrahati or grove dedicated to God generally to mother goddesses in the form of unshaped stones smeared with shendur are still preserved though in a degraded condition in the Western Ghats particularly in the districts of Pune, Kolhapur and Ratnagiri. Traditionally it was believed that breaking even a twig in the sacred grove may result in arousing the wrath of the deity. The deities, ferocious in nature may mete out to the offender punishment in the form of a serious illness or even violent death. Such strict taboo helped preserve the sacred groves of forests in its virgin condition. The sacred groves have now nearly vanished; these are reduced now to patches of forests stretching over only a few hectares. The sacred groves helped preserve many species of trees and climbers, orchids and ferns and forest loving birds and animals. They are not only naturalist's paradise but also are of vital importance in the conservation of forests, soil and water.

Twentyeight sacred groves in the Panshet dam catchment area have been reported; however seven of these have been totally destroyed and four are reduced to a cluster of a few trees and climbers. (Map 8) In fact all except five are in a

Chart 34

SUCCESSION OF PLANTS ACCORDING TO THE ZONES

I Zone

Ficus sp
Terminalia alata Heyne.
Bridelia squamosa Gerhm.



Meynealaxiflora Robyns.
Woodfordia fruticosa Kurz.
Lasiosiphon eriocephalus Dene.



Lantana camara L.
Carissa congesta Wigesto.
Artemisia parviflora Blam.



II Zone

Ficus sp
Actinodaphne angustifolia Nees



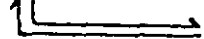
Terminalia alata Heyne
Bridelia squamosa Gerhm.



Meynealaxiflora Robyns.
Woodfordia fruticosa Kurz.
Lasiosiphon eriocephalus Dene.



Lantana camara L.
Carissa congesta Wigesto.



III Zone

Memecylon umbellatum Burm.
Syzygium cumini Skeels.



Butea monosperma Taub.
Terminalia chebula Retz.
Terminalia belerica Roxb.



Meynealaxiflora Robyns.
Xeromphis spinosa Keay.



Woodfordia fruticosa Kurz.
Lasiosiphon eriocephalus Dene.
Carissa congesta Wigesto.



IV Zone

?



Syzygium cumini Skeels.
Memecylon umbellatum Burm.



Ficus sp

Wrightia tinctoria Br.
Glochidion ellipticum Wt.
Casearia graveolens Dalz.



Erythrina variegata L.
Euphorbia nivula Buch.

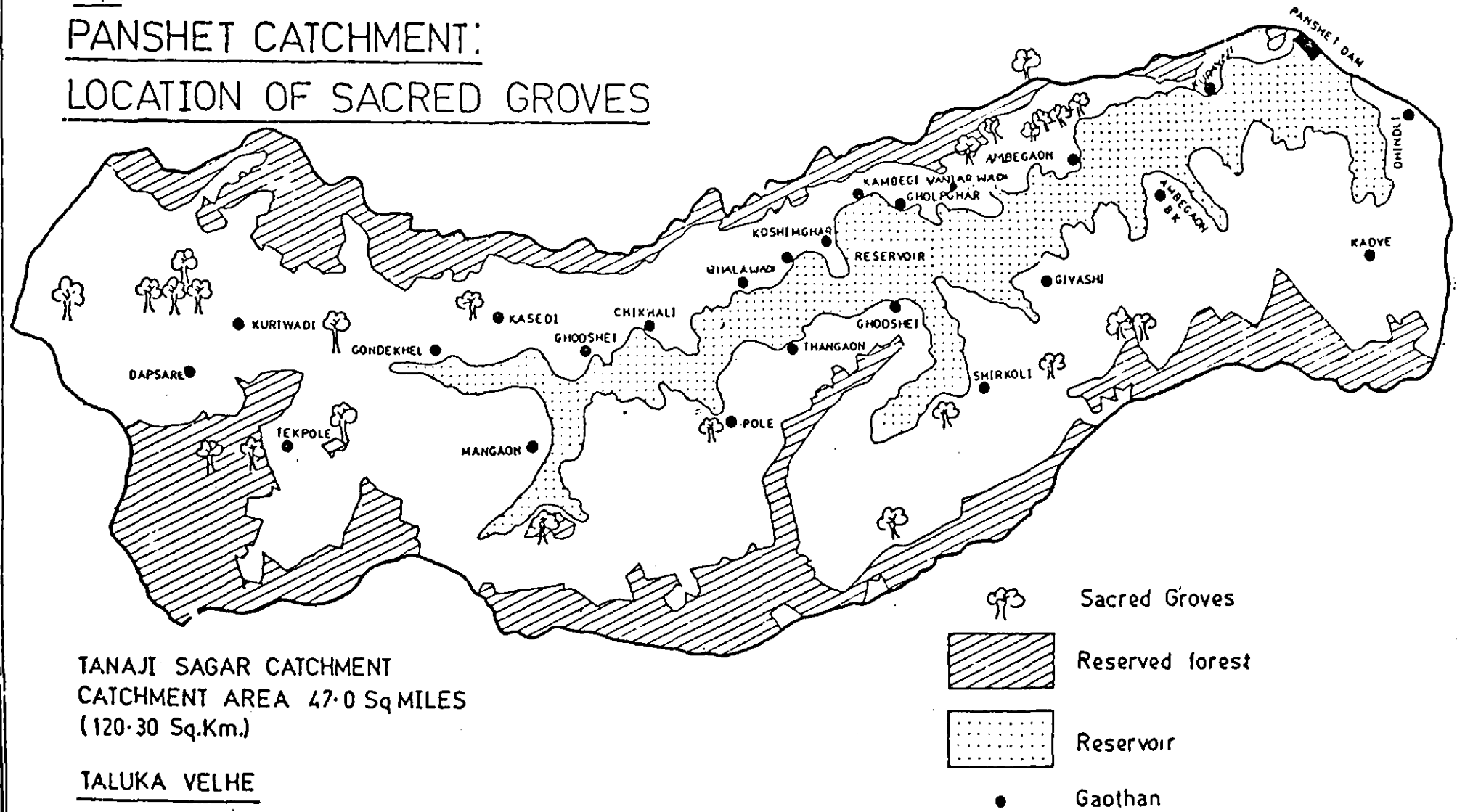
Themeda quadrivalvis O.Ktze
Heteropogon contortus P.Beauv



Oropetium sp
Eriocaulon sp
 Species of Commelinaceae

Map 8

PANSHET CATCHMENT: LOCATION OF SACRED GROVES



degenerated state because the villagers came to depend on the trees-shrubs in the sacred groves for timber and fuelwood as the nearby forest areas have been totally destroyed. Due to the availability of shade and some feed (climbers like Gnutum ula and tree leaves) cattle take shelter into the groves and forage around trampling the young seedlings, hampering natural regeneration. The trees in many of the groves are becoming sparser and the diversity of plant life is much reduced. In the sacred groves at Ambegaon, Kasedi and Gondekhal the shrub cover is dominated by Lantana camara or Carvia callosa. All the sacred groves except one are very small in size; 16 have an area of less than .5 hectare each. Only two sacred groves have an area of 1.5 hectares each and there is only one sacred grove which is large - the sacred grove at Mangaon that extends over an area about 14 hectares of land. (Table 3.2)

The principle plant community differs from grove to grove depending upon the rainfall, altitude, soil and size of the sacred grove, but Caryota urens and Ficus sp. are the common trees found in almost all the groves. Dysoxylum binectariferum which has gone extinct elsewhere in this region is seen only in the Mangaon sacred grove. Bassia latifolia is found only in the Gondekhal sacred grove. Celtis cinnamomea and Sterculia foetida are seen only in the Dapsare sacred groves. (Table 3.3) Some of the trees totally absent in the first zone are seen only in the Ambegaon, Givashi

Table 3-2

The Sacred Groves of Panshet Catchment
Past and Present

No.	Village nearby	Deity	Distance from village (km.s)	Height above MSL(ft.)	Area in Hectares		Preservation	Dominant Plants
					In the past	At present		
1	Ambegaon Kd.	Padnavati	0.5	2500	0.05	0.01	Poor	<u>Ficus arnottiana</u> Miq, <u>Terminalia bellerica</u> Roxb, <u>Lantana camara</u> L
2	Ambegaon Kd.	Talawati	0.5	2500	0.05	-	Destroyed	
3	Ambegaon Kd.	Viroba	1.0	2300	1.0	0.05	Poor	<u>Terminalia alata</u> Heyne, <u>Ficus</u> Sp <u>Lantana camara</u> L
4	Ambegaon Kd.	Bhairi	1.0	2500	0.5	-	Destroyed	
5	Ambegaon Kd.	Waghai	1.0	2500	0.5	0.01	Poor	<u>Terminalia alata</u> Heyne, <u>Erythrina variegata</u> L, <u>Lantana camara</u> L.
6	Ambegaon Kd.	Veer	1.5	3200	N.A.	0.5	Partial	
7	Vanjarwadi	Kalkai	0.6	2500	1.5	1.5	Moderate	<u>Terminalia alata</u> Heyne <u>Carvia callosa</u> Bremek.
8	Vanjarwadi	Pandhar-phali	0.6	2500	1.0	1.0	Moderate	<u>Terminalia alata</u> Heyne, <u>Carvia callosa</u> Bremek
9	Givashi	Mahadeo	0.1	2400	0.2	0.01	Destroyed	
10	Ambegaon b.	Rogoba	1.0	3500	N.A.	-	Destroyed	

Table 3-2 (contd.)

No.	Village nearby	Deity	Distance from village (km.s)	Height above MSL(ft.)	Area in Hectares		Preservation	Dominant Plants
					In the past	at present		
11	Givashi	Jogoba	1.0	3500	1.2	0.5	Poor	<u>Mallotus philippensis</u> Muell <u>Tragia hildebrandtii</u> Muell.
12	Shirkoli	Kalkai	1.2	-	10.0	-	Destroyed	
13	Shirkoli	Shirkai	0.25	2250	3.4	1.5	Poor	<u>Dendrocalamus strictus</u> Nees <u>Carvia callosa</u> Bremek, <u>Mangifera indica</u> L.
14	Shirkoli	Mhasoba	1.5	3200	0.5	-	Destroyed	
15	Shirkoli	Jingoba	1.0	2500	N.A.	0.01	Poor	<u>Syzygium cumini</u> Skeels, <u>Pouteria tomentosa</u> Buchn. <u>Pavetta bengalensis</u> Bremer.
16	Pole	N. A.	0	2500	N.A.	0.1	Poor	<u>Artocarpus heterophyllus</u> Lem
17	Ghodshet	N. A.	1.0	2000	N.A.	-	Destroyed	
18	Mangaon	Janni	1.0	2500	15	13.8	Good	<u>Syzygium cumini</u> Skeels, <u>Xylia dolabriformis</u> Benth, <u>Carvia callosa</u> Bremek.
19	Kasedi	N. A.	0.5	2500	N.A.	-	Destroyed	
20	Gondekhal	Somaji	0.3	2400	6.0	0.05	Poor	<u>Careya arborea</u> Roxb, <u>Picus</u> sp

Table 32 (contd.)

No.	Village nearby	Deity	Distance from village (km.s)	Height above MSL(ft.)	Area in Hectares		Preservation	Dominant Plants
					In the past	At present		
21	Tekpole	wardaini	0.5	2400	0.6	0.6	Good	<u>Memecylon umbellatum</u> Burm <u>Terminalia</u> sp, <u>Dendrocalamus strictus</u> Nees.
22	Tekpole	kalkai	0.3	2400	0.05	0.05	Good	As above
23	Tekpole	Jugai	0.4	2400	0.05	0.05	Good	As above
24	Dapsare	Jakhin	0.7	2500	0.5	0.5	Moderate	<u>Enteda phaseoloides</u> Merr <u>Nothapodytes foetida</u> Sleumer <u>Ficus</u> sp.
25	Dapsare	Kuthar	0.7	2500	0.5	0.5	Moderate	<u>Syzygium cumini</u> Skeels, <u>Celtis cinnamomea</u> Lindl, <u>Ficus</u> sp <u>Murraya koenigii</u> Spreng.
26	Dapsare	Shambhu	0.7	2500	0.65	0.65	Moderate	As above
27	Dapsare	N. A.	0.7	2500	2.0	0.5	Poor	As above
28	Dapsare	Kothmai	2.6	3600	N.A.	0.5	Good	<u>Neolitsea zeylanica</u> Merr, <u>Ficus</u> sp <u>Atlantia racemosa</u> Wight & Arn.

N. A. = Not available

Table 3.3 Rare plant species found in the different sacred groves.

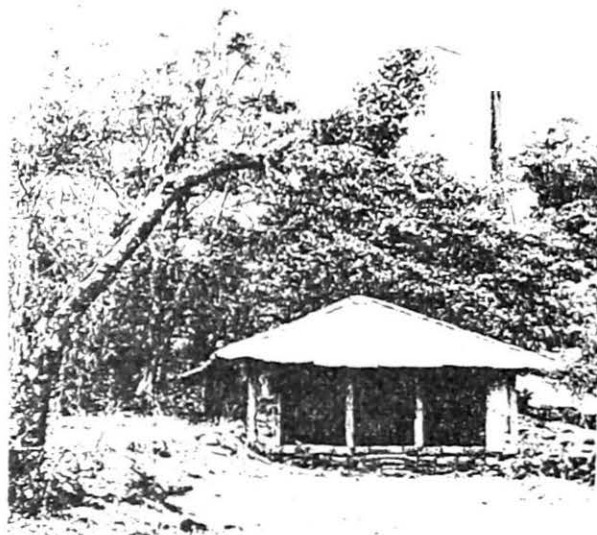
Second zone	Third zone	Fourth zone
Vanjarwadi	Mangaon	Tekpole
<u>Aeginetia indica</u>	<u>Alstonia scholaris</u>	<u>Coix</u> Sp
<u>Balanophora indica</u>	<u>Dysoxylum binectariferum</u>	<u>Dendrocalamus strictus</u>
<u>Ipomea</u> Sp	<u>Gnetum ula</u>	<u>Garcinia indica</u>
<u>Murraya koenigii</u>	<u>Lagerstroemia parviflora</u>	<u>Gnetum ula</u>
Givashi	<u>Remusatia vivipara</u>	<u>Piper nigrum</u>
<u>Grewia subinoqualis</u>	<u>Sterculia guttata</u>	<u>Pothos scandans</u>
<u>Tragia hidebrandtii</u>	<u>Xylia dolabriformis</u>	Dapsare
	Gondekhal	<u>Celtis cinnamomea</u>
	<u>Madhuca indica</u>	<u>Gnetum ula</u>
		<u>Neolitsea zeylanica</u>
		<u>Nothapodytes foetida</u>
		<u>Sterculia guttata</u>

and Vanjarwadi sacred groves. In the same way the plants not seen in zones II and III are seen in the Gholapghar and Mangaon sacred groves. Presence of the following evergreen and semi-evergreen trees in the sacred groves dedicated to Janni, Waradani, Kalkai, Jugai, Jakhin, Kuthar and Kothamai provides a rough clue to the past picture of the catchment. The common trees are Xylia dolabriformis, Memecylon umbellatum, Celtis cinnomomea, Olea dioica, Nothapodytes foetida, Mæcaranga peltata, Murraya exotica, Syzygium cumini and Caryota urens, shrubs like Ixora nigricans, Allophylus cobbe, Carissa congesta and climbers like Piper betel, Entada pursaetha and Gnetum ula. It appears that this catchment with very high rainfall enjoyed a different type of vegetation in the past, mostly dominated by the evergreen or semi-evergreen trees. During the monsoon and in the early winter some interesting plants like Aeginetia indica, Balanophora indica are seen in many sacred groves.

Shirkai Sacred Grove: The grove devoted to Shirkai at Shirkoli that extended over some 4 hectares is now reduced to 1.5 hectares. The cutting and hacking of trees in the sacred grove is continuing for some decades. Hardly any rare species are preserved, except for Zanthoxylum rhetsa. Despite the encroachment the faith in the presiding deity persists. It was narrated that in February 1983 the villagers from the neighbouring village Givashi prayed Shirkai to permit them to cut bamboos from the Devrahati as they were celebrating the



9. Pandharpali Sacred Grove



10. Somjai Sacred Grove



11. Images of Mother Goddesses in Somjai Temple



12. Janni Sacred Grove - Mangaon

function of installing Alubai, Bhairi and Maruti in their village. Shirkolikars (inhabitants of Shirkoli) requested them to take the bamboos only from the submerged areas. The Givashikars however cut the bamboos from the Devrahati; there arose a dispute and Padwal (Devacha mankari) appealed to Shirkai to punish Givashikars. Three days later when the Givashikars were busy with their religious function, the children were playing in the house; accidentally one hut caught fire and several huts were ablaze. The Givashikars suspected the wrath of the supernatural.

Waradani Sacred Grove: The sacred groves in Tekpole and Dapsare adjoin a stream and as these sacred groves are well preserved the streams are fed by perennial springs. The tree canopy helps slow down the speed of the gushing waters, the litter helps retain the moisture. The tree and shrub cover thus regulates the water movement and protects perennial springs. Drying up of perennial stream with felling of forests has been reported (Gadgil, Vartak 1973). The sacred grove at Tekpole is devoted to Waradani - a water deity - a goddess common along the crest of the Sahydris in the Pune district. The stream that adjoins the grove is a perennial source of water to the villagers. At Tekpole traditional taboos, prohibition on women to enter the grove is still observed. It is believed that some calamity befalls the villagers, if a woman enters the grove.

Janni Sacred Grove: The sacred grove at Mangaon being large provides diverse habitat and is rich in plant species. It was studied in 1973 by Vartak/Gadgil. Vartak & Gadgil (1981) reported more than 90 plants species from the Janni sacred grove and the neighbouring localities. (See Table 3.4) They mentioned that the grove occupied an area of 16 hectares and was well protected. But the present size of the grove is 13.8 hectares and it is moderately preserved. Although the same characteristic species like Dysoxylum binectariferum, Syzygium cumini and Memecylon umbellatum are the dominant plant community there is a progressive deterioration of the grove. The process is following two different ways, (a) slow shrinkage from the periphery (b) and reduction in the number of plant species per unit area. The outer region is dominated by certain plant species, which are characteristic in secondary succession; these are Gymnosporia rothiana, Lasiosiphon eriocephalus, Meynea laxiflora, Fagaria budrunga and Terminalia bellerica. There is an increase of Diploclasia glaucescens in the middle of the grove. To study the present vegetation a quadrat study was carried out in 1984, covering the middle portion of the grove. Fig. 3.9 indicates the frequency, abundance and density of the individual plant species and Fig. 3.10 indicates the frequency of different plant groups in Janni sacred grove.

Trees like Xylia dolabriformis, Dysoxylum binectariferum, Nothapodytes foetida, Syzygium cumini are dominant, while shrubs

Table 3.4

Vegetation of Mangaon Janni grove (1973)

Type of vegetation : Sub tropical broad leaved
hill forests.

Above 25 m

Occurrence

Anthocephalus cadamba

O

Caryota urens

C

Dysoxylum binectariferum

F

Lagerstroemia parviflora

F

Mangifera indica

C

Sterculia guttata

F

Syzygium cumini

*

Terminalia bellerica

O

Xylia dolabriformis

F

15 to 25m

Actinodaphne angustifolia

A

Alstonia scholaris

O

Bauhinia racemosa

F

Bridelia squamosa

C

Fagara budrunga

O

Ficus glomerata

O

Flacourtia indica

O

Macaranga peltata

C

Murraya koenigii

C

Olea dioica

A

Terminalia chebula

C

5 to 15 m

Allophyllus serratus

*

Bauhinia racemosa

F

Casearia graveolens

C

Ficus arnottiana

F

Leea indica

C

Memecylon umbellatum

*

Meynea laxiflora

F

Wedlandia thyroidea

*

Wrightia tinctoria

F

Xeromphis spinosa

F

Woody shrubs

- Atalantia racemosa
- Carissa congesta
- Crotalaria retusa
- Lasiosiphon eriocephalus
- Pogostemon parviflorus
- Thelepaepale ixiocephala

Climbers

- Acacia pinnata
- Acacia rugata
- Celastrus paniculata
- Dalbergia sympathetica
- Dioscorea pentaphylla
- Elaeagnus conferta
- Entada phaseoloides
- Gnutum ula
- Zizyphus rugosa

Herbs

- Adelocaryum coelestinum

- C
- C
- F
- C
- F
- A
- F
- *
- F
- C
- C
- C
- O
- F
- C

- Aerva Sp
- Ecboium linneanum
- Halanthus tentaculatus
- Hemigraphis latebrosa
- Impatiens kleinii
- Piper nigrum
- Rubia cordifolia
- Parasites
- Aeginetia indica
- Dendrophthoe falcata
- Striga gesneroides
- Taxillus cuneatus
- Viscum angulatum
- Epiphytes
- Aerides maculosum
- Dendrobium barbatulum
- Eria dalzellii
- Liposorus nudus
- Microsorium membranaceum

- Oberonia recurva
- Pothos scandens
- Remusatia vivipara

- A - abundant
- F - frequent
- C - common
- O - occasional
- R - rare
- * - species characteristic of the type.

Fig. 39

MANGAON SACRED GROVE

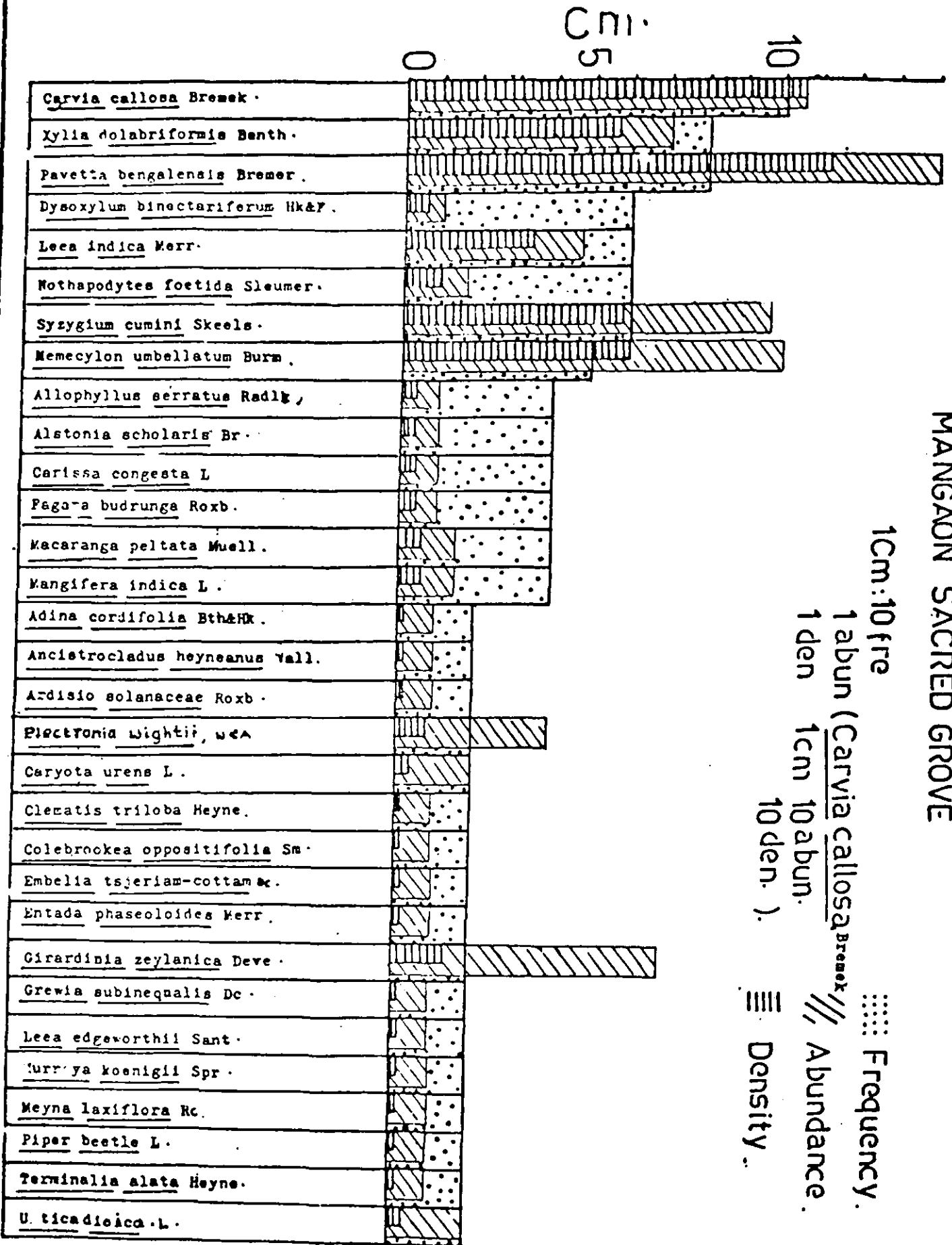
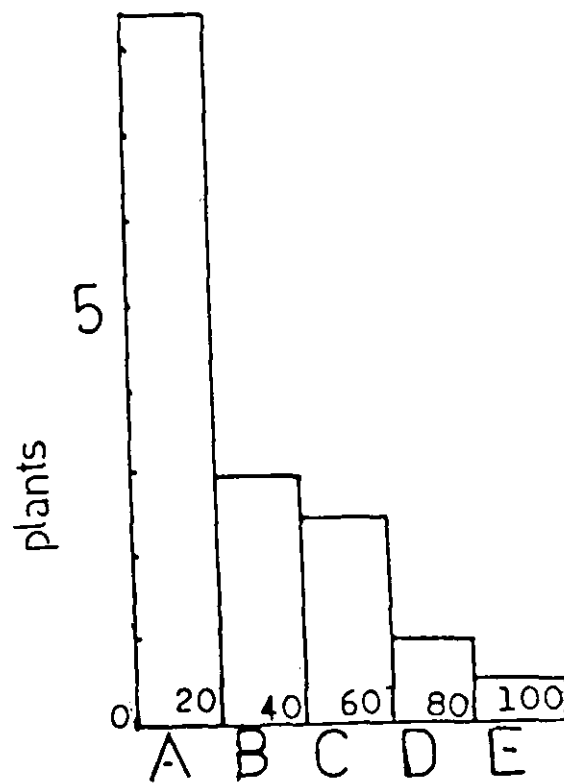


Fig 3.10

MANGAON SACRED GROVE

| : 2 plants



(Raunkiaer's frequency diagram)

like Carvia callosa, Pavetta bengalensis and Leea indica are dominant in the sacred grove. Alstonia scholaris, Macaranga peltata, Mangifera indica are common trees and Carissa congesta is a common shrub in the sacred grove. Certain plants like Caryota urens, Murraya koenigii, Enteda pursaetha and Piper betel are occasionally seen.

Distinct Characters of the Sacred Groves: The sacred groves are the only arboreal vegetation in the catchment area where different layers of canopy can be seen. The presence of a variety of plant species and restricted appearance of some plants in the sacred groves indicates the past vegetation of the catchment area. Most of the sacred groves are situated on the middle contours and also many of these groves are located on the source regions of the streamlets on which most of the villages are completely dependent for their daily water needs. The vegetal cover in such sensitive regions not only prevents the velocity of rushing rain waters but also prevents soil erosion. The sacred groves are giving harbour to many fire sensitive and shade loving plants and many of these plants have got economic importance. Many plants species noted in the sacred groves have disappeared from the catchment area. Many plant species of no known economic value today and on the way to their extinction may acquire significance in the future. As the tropical plants are yet to be studied from the viewpoint

of potential new uses, it is important to protect the biological diversity. Besides, the groves may support genetic variants of common trees which may be valuable in a future forest tree breeding programme.

Conservation of sacred groves is thus vital for the preservation of the wealth of the Western Ghats. Serious steps have to be taken urgently as these are no more conserved and protected on religious belief. The lack of alternative sources for timber and fuelwood is driving people to encroach upon the sacred groves. An immediate programme for firewood and timber tree plantation, prohibition of commercial exploitation of the forest resources of the catchment area, and a plan of systematic redevelopment of the sacred groves and full protection to the existing vegetation in the grove has to be prepared forthwith and implemented in cooperation with the local inhabitants.

CHAPTER IV

Economic Conditions of the Dam-Affected Families

1. Large Dams in Mutha River Valley:

The importance of Poona city, the Capital of Peshwas between 1720 and 1818 revived, with the adoption of Poona as the seasonal Capital of the Bombay Presidency by the British and the construction of railway in 1860's. For the growing city the arrangements for water supply made by the Peshwas proved inadequate. The government decided to construct a reservoir with a capacity of 3000 m.cft. on Mutha river, 16 kms. upstream of Poona, near Khadakwasla village. The work commenced in 1869 and was completed in 1879.

The rapid expansion of the city in the post 1947 period increased the demand for the city water supply and there was a progressive curtailment in the irrigation water supplied from the Khadakwasla reservoir. To augment the water storage, three proposals were under consideration in the early 'fifties. (i) to build a new dam on the down-stream side of the Khadakwasla dam with a capacity of 15000 mcft. (ii) to raise the height of the existing Khadakwasla dam (iii) to construct two masonry dams, one at Panshet across the river Ambi and the other at Warasgaon across the river Moshi, the tributories of Mutha river. In 1955, the first proposal was favoured. However the experts of the Central Water and Power Commission brought up a new

proposal of building two earthen dams and it was accepted mainly on account of somewhat lower cost estimates. (Brahme, Gole, 1967)

The Panshet Dam: The estimated cost of the Panshet Dam with a capacity of 11000 mcft. was about Rs. 2.75 crore. The construction work was started in 1957 and it was to be completed by May-June 1962. The progress was slow, yet in 1960 it was decided to complete the work by May 1961. The decision to impound water in 1961 was taken in April 1961 when a considerable work was half-complete. Half the earth-work completed in the last season was raw. The approach bridge to the tower was not ready. Hoisting arrangements were not installed so that the service gates could not be operated. Pitching on the upstream side was not completed to the full height.

In 1961, the rainy season set in, in the second week of June and in three weeks the dam was full. Strong winds caused severe wave-wash and the embankment was in danger. Attempts to save the embankment failed and on 12th July 1961 the embankment was overtopped; the torrent of water swept away a 400 metre portion of the embankment. The torrential floods mounted heavy pressure on the Khadakwasla embankment and the middle portion of the dam was sheared off. Extensive areas along both the banks of river Mutha which flows through the centre of Poona city were flooded and several buildings

collapsed. The estimated loss caused due to the collapse of the Panshet dam amounted to Rs. 17.5 crore. (Brahme, Gole, 1967)

The work on the reconstruction lingered on considerably. The design was changed from earthen to masonry-cum-earthen. The cost of construction mounted to Rs. 8 crore. The fate of the displaced families remained in a flux for over a decade. Water was impounded in the Panshet reservoir in the year 1972.

2. Survey Methodology:

The present study relates to the entire catchment area of the Panshet reservoir. 24 villages were affected due to the construction of the Panshet reservoir. Information on topography, climate and forest lands in the catchment was collected from the official statistical sources and the concerned Government departments. Village level information on geographical area, land use, crop pattern and livestock composition was collected from the village records and the panchayat samiti records. The rehabilitation office records were consulted to obtain the data on land acquisition. Data on population was obtained from the 1981 Census records. To obtain the figures relating to the quantity of milk delivered to the Poona District Milk Producers' Cooperative the records at the Katraj office of the cooperative were consulted.

For in-depth study four villages, one from each of the four zones, were selected. Information on the following aspects was obtained through family level schedules filled in by personal interview from all the families in the selected villages, field observation and field measurement. The family schedule covered the following aspects:

- (a) Land owned prior to 1955, land acquired by the Government, compensation received, position as regards the land offered in Daund taluka.
- (b) Family composition, occupation, wage employment and wage rate, cultivation practices, volume of production by crop, quantity of fuelwood and other forest produce collected and sold.
- (c) Livestock, agricultural implements and other durables owned.
- (d) Size of the house, material used for housing.
- (e) Daily intake of food by item, health status and ailments.
- (f) Problems faced due to the loss of land, deforestation and suggestions for redevelopment.

The families approached for interview were quite cooperative. Four families from Shirkoli were requested to maintain daily records of work and food intake for obtaining a broad picture of the seasonal variations in these respects. The information on agricultural production, fuelwood collected and bhakari eaten was obtained respectively in units of bags,

moli and number. The estimation of weight was made through actual sample weighments. The area of the plots under shifting cultivation is generally not known. The plots are on slopes and very irregular in shape. To estimate the productivity quadrats were taken and the crop harvested from the selected quadrats was measured. Similar method was used to estimate the production of grass. The quantitative estimates are thus approximate; they are presented to get a broad indication of the dimensions involved.

3. Dam-affected Families:

When the decision to impound water was taken in 1961 the families in the submergence area were shifted. Majority of the families moved to the villages relocated on the middle slopes of the hill ranges and a section moved to the new villages in the Daund taluka, where the families were offered substitute agricultural lands.

Lands were acquired from 1118 families from the Panshet reservoir catchment area and 184 families from villages Kuran Budrak and Kuran khurd located near the dam site. (Table 4.1) A large number of families from zone I were displaced. Villages like Kuravati and Dhindli lost about 66 per cent of the village lands. All the other villages from zone I except Kadve, which does not come directly under submergence, lost the rich valley lands under paddy cultivation. About 31 per cent of the

Table 4.1: The Number of Dam-affected Families and the Land They Lost Due to Panshet Reservoir

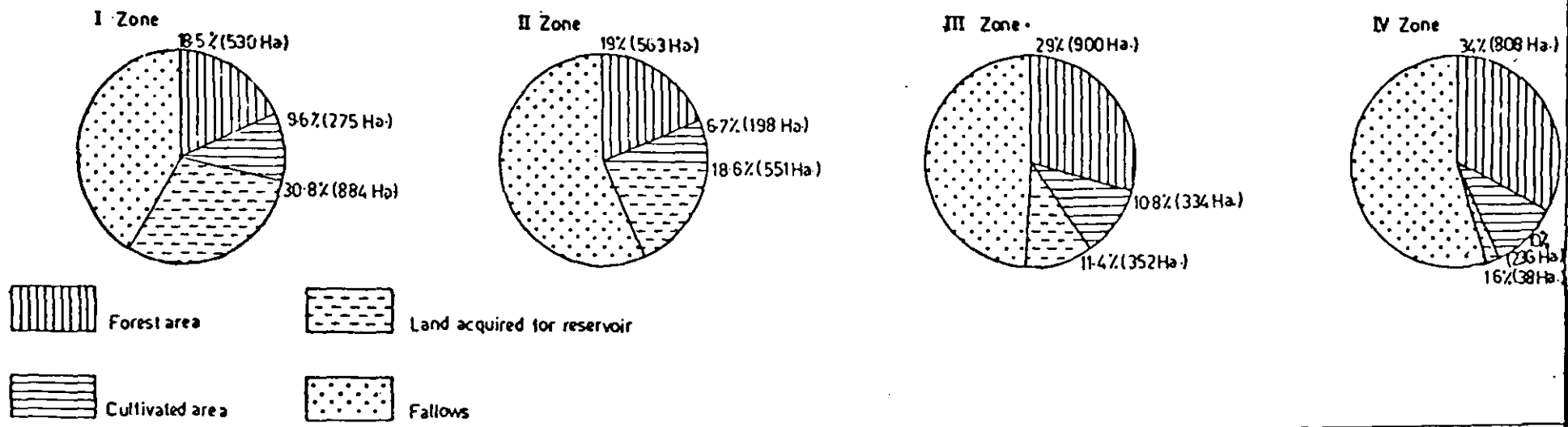
Village	No. of families affected	Area acquired for reservoir (Ha)	Total village land before acquisition (Ha)	Percentage of land acquired to total village land
Panshet	21	49	87	56.3
Kuravati	20	129	193	66.8
Ambegaon khurd	119	220	521	42.2
Dhindli	23	109	165	66.1
Kadve	90	142	844	16.8
Vadghar	100	119	458	26.0
Ambegaon budruk	94	116	602	19.3
<u>Zone I</u>	467	884	2870	30.8
Gholapghar	49	77	175	44.0
Kambegi	36	56	209	26.8
Koshimghar	45	72	165	43.6
Bhalawadi	39	79	261	30.3
Givashi	73	74	385	19.2
Shirkoli	80	59	1316	4.5
Ghodshet	24	52	141	36.9
Thangaon	50	82	307	26.7
<u>Zone II</u>	396	551	2959	18.6
Chikhali khurd	28	37	122	30.3
Kasedi	32	52	228	22.8
Ghodkhal	36	61	377	16.2
Gondekhal	15	83	490	16.9
Pole	56	69	805	8.6
Mangaon	49	50	1066	4.7
<u>Zone III</u>	216	352	3088	11.4
Tekpole	39	38	1004	3.8
Kurtawadi	-	-	549	-
Dapsare	-	-	833	-
<u>Zone IV</u>	39	38	2386	1.6

total village lands in zone I were acquired. (Fig. 4.1) Consequently only a part of the families remained in the catchment area as there was little cultivable land available. Many moved to the villages in the Daund taluka. It is estimated that about 120 families moved out from Panshet, Kuravati, Dhindli, Ambegaon kh. and Ambegaon budruk. In the second zone about 20 to 30 per cent of the village lands were acquired, except for Shirkoli which is located on a tributary of river Ambi at some distance from the river Ambi. It is a large village with 1316 hectares of which 59 hectares were acquired. About 25 to 50 families each moved out from Givashi, Koshimghar and Gholapghar. The estimated number of families moving out of this zone was about 140. In the third zone, 30 and 23 per cent of the land was lost in Chikhali and Kasedi respectively, while the proportion was less than 20 per cent in the rest of the villages. The villages from zone IV, viz., Kurtawadi and Dapsare were not affected while Tekpole was marginally affected. In cases where the loss of agricultural lands was not considerable only a few families shifted to the villages in the Daund taluka. Some of the displaced families migrated to Bombay or Pune.

According to the Government records, of the 1302 affected families, agricultural lands were made available to 1177 families in different villages in the Daund taluka - an eastern taluka of Pune district lying in the drought-prone tract.

Fig 4-1

PANSHET CATCHMENT; LANDUSE PATTERN



Land was offered at the rate of two acres per family in villages like Undawadi, Pimpalgaon, Pargaon, Kedgaon, Sonwadi, Rajegaon, Patas, Yavat, Kedgaon etc. Many of the families who were offered alternative land did not shift for a variety of reasons. The main complaint was that the lands were rocky, murmy, and not fertile and hence not cultivable, or they were infested with babul trees and the families did not have the means to clear the lands and bring it under plough. Some of the families who had taken possession of the land did not shift, but are leasing out the land in Kedgaon, Pimpalgaon etc., on a crop-share basis receiving a share of about 1 to 2 quintals of jowar per year. The families have not shifted mainly because the land is not adequate for the maintenance of a family. A feeling was also expressed that it is painful to move from the hilly heavy rainfall tract to such dry-low rainfall area; besides they cannot maintain their cattle (as they do in the hill region) due to the shortage of fodder. Some who had shifted returned back due to the opposition from the local villagers. In some cases it was reported that one of the brothers or sons was looking after the cultivation of land in the Daund taluka. The produce of the land-about 4 to 5 quintals of Jowar, supplements their nachani production. Many of those who have shifted and settled in the Daund taluka are forced to depend mainly on the wage work. It was reported that only a few families who have been able to

procure a share in the water lifted from the river Bhima have viable agriculture.

The families were given cash compensation for the agricultural land and other land acquired by the government. Information in this regard was collected from the surveyed families. The amount received by the families in the 1st zone was considerably more as they had lost large areas of land. The average came to Rs. 4760 per family in the 1st zone, Rs. 2,250 in the 2nd zone, Rs. 1,750 in the 3rd zone and Rs. 1,640 in the 4th zone. Compensation for the loss of other land, house, trees etc., was also paid. This came on an average to Rs. 2,400 per family. These small amounts received by way of compensation were exhausted within a year or so and the families were left only with a small area of cultivable land that could not possibly provide them with a succour. The construction of dam affected some 1300 families majority of whom was not properly rehabilitated. The present study will deal only with the families that have stayed on in the catchment area of the Panshet dam.

4. Population:

There were 974 families in the 24 villages in the Panshet catchment area in 1951. In 1960 it is estimated* that

* The exact number of the families who out-migrated cannot be known as they have shifted some 25 years back and no records are available on migration. The estimate is made on the basis of information obtained from the elderly members of the families staying in the region.

about 300 families shifted from these villages. The total number of families according to 1961 Census was 1132, with 5876 persons. (Table 4.2) The number decreased in the following decade and in 1971 the number of families was 976 with 4,983 persons. Majority of families displaced due to the construction of the Panshet dam continued to stay in the catchment area and the number of families leaving either for the villages in the Daund taluka or for Bombay/Pune in search of a job is relatively less, though a few families do shift every year. After 1971, some decline in the total number of families is noted. The total number of families in the catchment was 959 according to 1981 Census and the estimated number in 1984 was 920 households.

Nevertheless, it is important to note that the lands from one village viz., Gholapghar were purchased in 1981 by some four-five salariat service families from Pune; and all the villagers left the village. The danger of encroachment by the urban speculators is not serious at the moment as there is no pukka motorable road or a regular launch service. However definite policy measures have to be worked out in advance so as to obviate this danger.

The size of the villages (1981 Census) varies from 6 households (Dhindli) to 134 households (Kadve); the size varies according to the availability of land for cultivation. Kadve and Vadghar in the Ist zone are relatively larger villages

Table 4.2: Population of the Villages in the Panshet Catchment Area at 1951, 1961, 1971 and 1981 Censuses

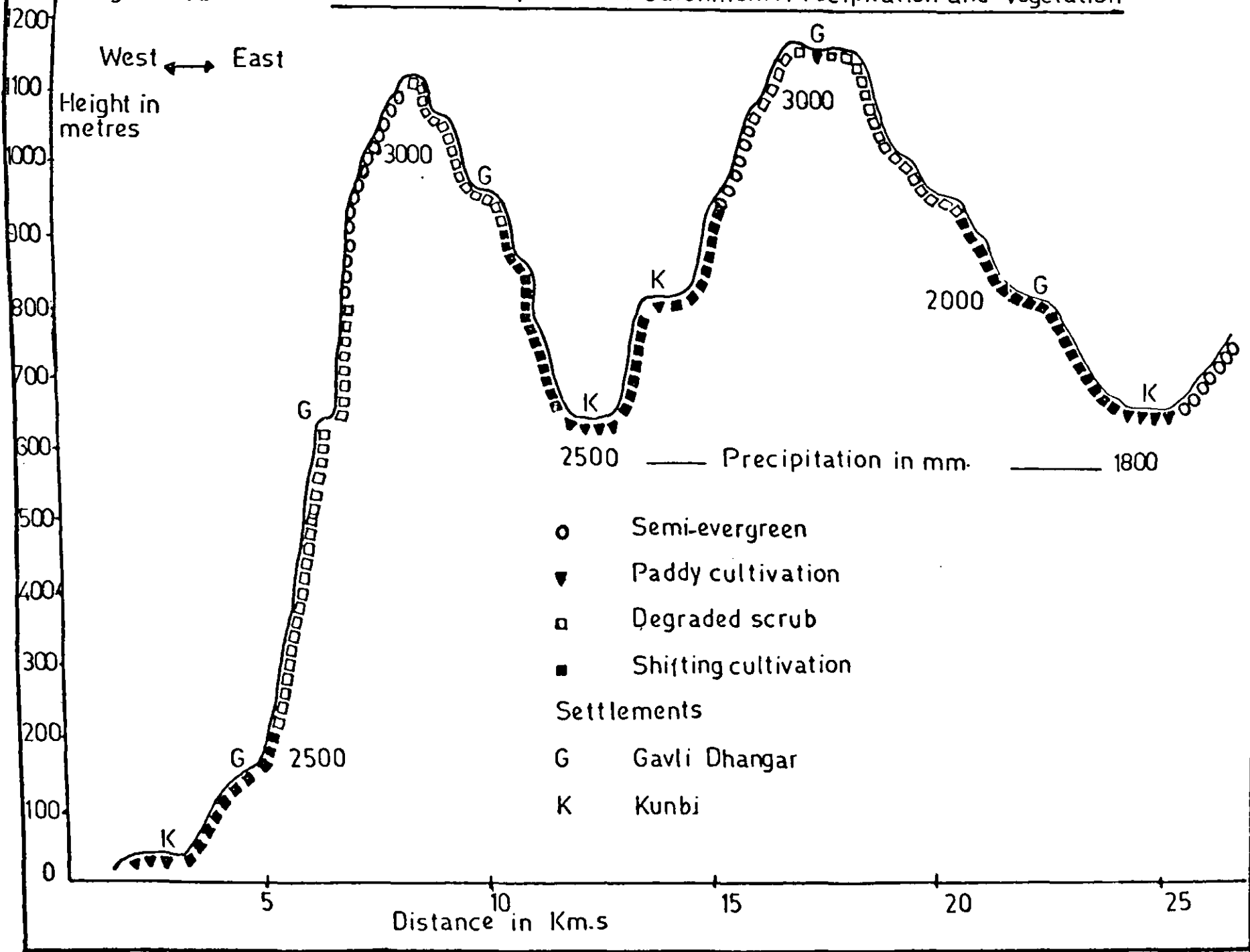
Village	Population			1981	
	1951	1961	1971	Population	No. of households
Panshet	61	141	75	71	9
Kuravati	73	78	113	70	13
Ambegaon khurd	464	341	344	339	65
Dhindli	48	154	64	37	6
Kadve	461	779	681	741	134
Vadghar	309	493	257	276	60
Ambegaon budruk	252	132	196	137	36
Zone I	1668	2118	1730	1721	323
Gholapghar	128	145	41	2	1
Kambegi	113	115	124	95	21
Koshimghar	117	190	164	112	25
Bhalawadi	83	132	125	119	23
Givashi	225	231	214	171	35
Shirkoli	385	515	481	471	94
Ghodshet	61	61	48	44	9
Thangaon	167	205	138	164	29
Zone II	1279	1594	1335	1178	237
Chikhali khurd	79	128	68	36	8
Kasedi	127	188	179	178	32
Ghodkhal	104	107	112	110	23
Gondekhal	137	173	209	128	39
Pole	259	315	402	260	72
Mangaon	297	397	335	369	81
Zone III	1003	1308	1305	1171	255
Tekpole	321	644	423	405	88
Khrtawadi	32	63	38	66	12
Dapsare	96	149	152	187	44
Zone IV	449	856	613	658	144
G.Total	4399	5876	4983	4723	959

with some land under permanent cultivation. In the IIInd zone Shirkoli, located in a small valley had 94 families. Mangaon in the IIIrd zone and Tekpole in the IVth zone that have some table lands had 81 and 88 families respectively. Most of the other villages had 20 to 40 families each. The families in many of the villages are distributed in two major distinct settlements. The Kunbi peasant settlements are located on the hill slopes while the Gavli Dhangar hamlets are situated mainly on the upper plateau region. The Dhangar hamlets of a village are generally scattered in two-three locations, each hamlet usually having only about 2 to 4 households. The Dhangars depend mainly on milch cattle for their livelihood; as the territory needed for grazing the herd of each family is considerable (about .5 sq.km.) the number of families in each hamlet is very small.

The terrain in the Panshet catchment area, as noted earlier is made up of narrow valleys with steep hills forming stepped terraces leading to the flat hill tops (fig. 4.2). Before the construction of the dam the valleys and the lower hill slopes were cultivated by the Kunbi peasants and their villages were located in the valleys. The Gavli Dhangar settlements were situated on the upper terraces and they utilized the upper slopes and the hill tops. However with the construction of the dam the peasants were pushed up to the middle terraces; with the loss of the rich rice lands, the pressure on the relatively

Figure 4.2

Cross section of Panshet Catchment: Precipitation and Vegetation



poor and limited resources of the middle and upper terraces increased.

The main Dhangar settlements in the Panshet catchment area are located on the ranges to the southern side of the lake while of the settlements situated on the northern side some belong to the villages located on the northern slope that fall in the catchment area of the Warasgaon dam. The largest number of Dhangar families are found in the Dhangarwadis of Pole village followed by Tekpole. There are several wadis at Pole like Mhaskar Dand, Pangaryacha Dand, Devacha Mal, Pimpal Mal, Upsal, etc., where Dhangar families varying from one to six are staying. Dangekhind - a Dhangarwadi of Shirkoli is a relatively large wadi with twelve Dhangar families. Givashi, Thangaon, Mangaon, Gondekhal, Dapsare, Vadghar, Ambegaon, Kadve, Kambegi, Kasedi have Dhangar settlements.

Of the total population residing in the catchment area, the estimated number of Gavli Dhangar Households staying in the Dhangar wadis was 220 and that of peasant and other households staying in the main villages was 700. The average family size was around six persons in the case of Gavli Dhangar households and about 5.5 in the case peasant households. The estimated total population of the area in 1984 was about 5100. The number of females per 1000 males was 944 for the region as a whole. The working age group (14 to 55 years) population

formed nearly 60 per cent of the total population (Table 4.3). The children between the ages of 0-5 constituted about 12 per cent of the total population and the children of school-going age i.e. between the ages of 6 and 13 formed 19 to 22 per cent of the total population in the different zones. Of the total of about 1000 children of school-going age, very few children attended school regularly. Primary school in Kadve has 3 teachers and the classes run regularly. There were about 130 children enrolled in the school, of these 65 per cent were boys. The school in Shirkoli had 2 teachers and 100 students. The schools in most of the other villages are not running regularly. The reported number of students in these villages was 235 boys and 150 girls. The total number for the entire region comes to 485, of which only about a quarter attended the school regularly. About 30 students mainly boys attended the middle school at Panshet, a few of them from the interior villages like Tekpole stayed at Panshet. Most of the children are in fact working children. The girls look after their younger siblings, help in cleaning, washing and in collecting fuelwood, the boys tend cattle and collect fuelwood, and do not find time to attend school.

5. Infrastructural Facilities in the Catchment Area:

The villages in the catchment area got totally cut off from the outside world when the lake was filled up. Previously

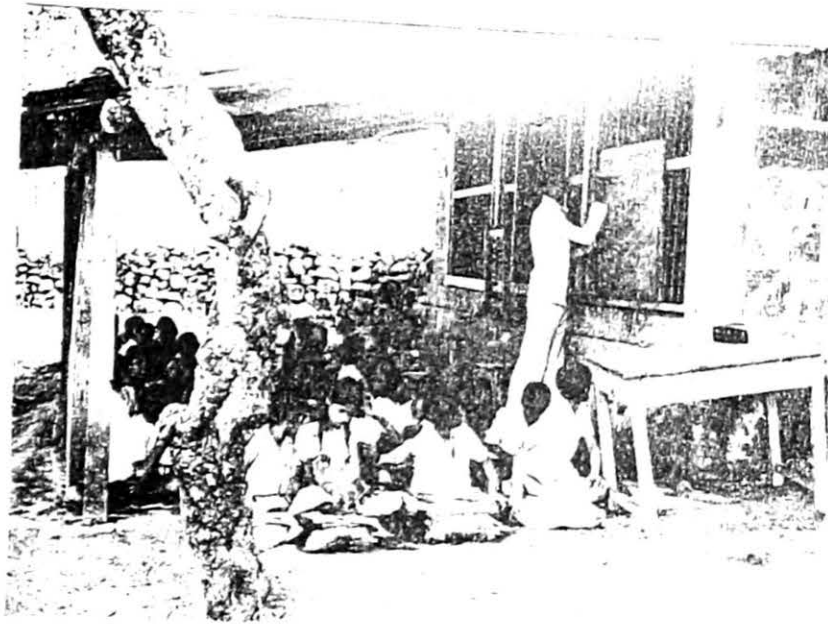
Table 4.3: Age Distribution of the Population
in the Panshet Catchment Area

(Figures in Percentages)

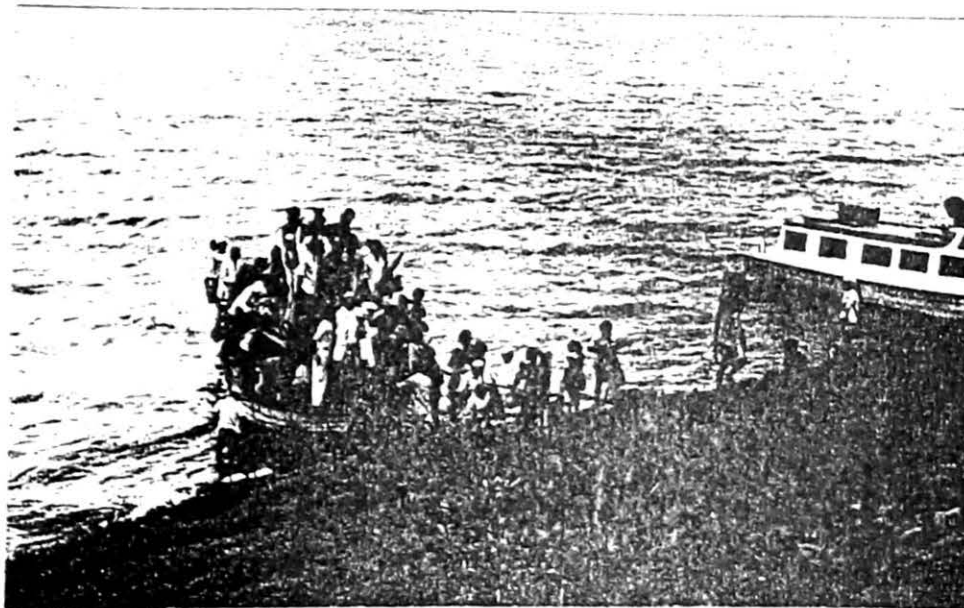
Age group (years)	Male	Female	Total population
0 - 4	8.5	7.8	8.2
5 - 8	10.6	10.4	10.5
9 - 13	11.7	11.5	11.6
14 - 18	10.1	10.0	10.0
19 - 24	11.3	11.0	11.1
25 - 34	15.5	15.9	15.7
35 - 44	12.5	12.7	12.6
45 - 54	9.2	9.6	9.4
55 and above	10.6	11.1	10.9
Total	100.0	100.0	100.0

even though there was no motorable road there was a cart tract. The distance between the village and Panshet was also much less as the villagers could take the path along the valley, which got submerged, increasing considerably the distance upto the villages in the interior. The distance from Panshet township to Mangaon is about 30 km. and upto Dapsare via Gondhekhali it is about the same. There is no regular launch service. The launch operated by the Poona District Milk Producers' Cooperative leaves Panshet around 3.30 a.m. and touches several villages to collect milk and returns to Panshet by 9.00 a.m. It is thus possible to get to Panshet township in the morning. However it is not possible to return back the same day. There is no communication after the launch returns to Panshet in the morning. Kaccha motorable road between Panshet and Gondhekhali and Panshet and Shirkoli has been recently developed and state transport bus service operates between Pune and Gondhekhali and Pune and Shirkoli only between January (kaccha roads have to be repaired after the Monsoon and are ready by January or so) and May once a day. Villages in the interior like Tekpole, Dapsare are inaccessible for part of the year (from mid-August to February when the lake is full launch can reach upto Tekpole). The villagers bear tremendous hardship particularly in cases of emergency like sickness, delivery, accident, snake bite.

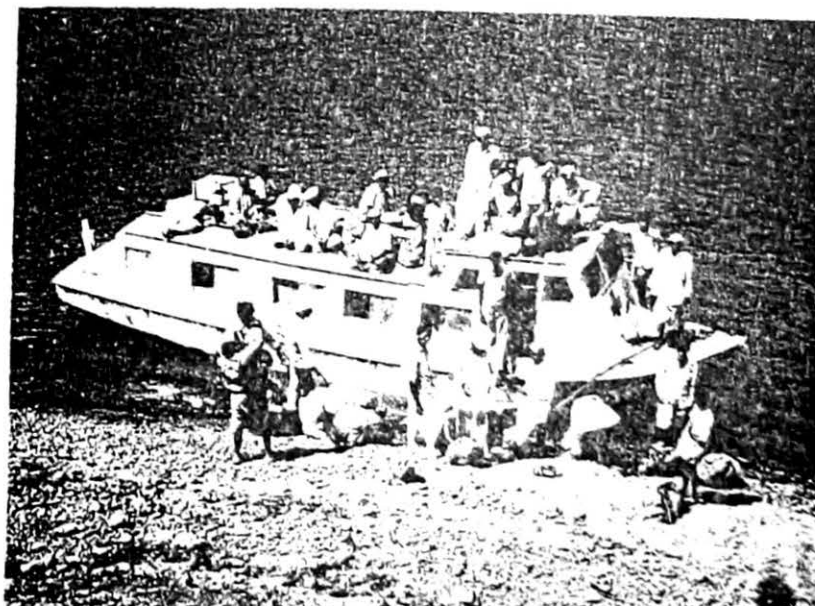
The villages being small in size there are no shops except for a grocery shop in bigger villages like Shirkoli,



13. Primary School Class in Shirkoli



14. Poona District Cooperative Milk Federation's Launch



15. Doctor's Launch

Mangaon. There are no flour mills except in Koshimghar and Shirkoli. No village in the catchment area is electrified. There was no medical service till 1978 when the Zilla Parishad organised mobile medical service, four days a week, when doctors' launch visits selected villages, stops for a while and the doctors attend routine cases. There are one-teacher primary schools in most of the villages. However the schools are almost non-functioning except for the school in Shirkoli, Kadve.

Panshet township developed near the dam-site since the fifties when the construction work on the dam started serves as the main centre for all the villages in the catchment area for services like grinding the flour, milling paddy, medical service, veterinary service, high school education and purchases of the daily necessities.

Drinking Water: As the villages are located on the middle ridges, the distance upto the lake is considerable and it increases as the water level recedes from December. Lake is the main source of water supply for many villages. There are one/two wells in a few villages. Another source of water supply is spring - but the springs in most villages dry up in summer months. Fetching water is a daily task that turns quite time-consuming and tiresome in summer. The Dhangars residing on the plateau face acute problems of water shortage particularly in summer.

They have to carry water from 2 to 3 km., distance up the hill and even have to transport drinking water for their cattle. They usually deliver the milk at the launch head and fetch water while returning. Many Dhangar wadis are situated at a distance of over 2 km. from the central villages and they have to walk up to the nearby bigger central village for the purchase of groceries, for delivery of milk and for launch service or even up to Panshet township for medical service, for purchases etc. This is difficult in the rainy season when there is a torrential down-pour and they have to make provision of fodder, fuelwood, groceries and such other basic essentials to tide over the period of heavy rainfall.

6. Land Use:

According to the official statistics 2801 hectares or about 29.5 per cent of the total land is classified as forest and is under the charge of the forest department. (Table 4.4) However, in actual fact most of the area classified as forest is without any tree cover particularly in zones I and II, and many of the villages from zone III. Forest patches are found only in a few villages like Shirkoli, Mangaon, Tekpole, Kurtawadi and Dapsare. About 47 per cent of the land is classified as grass-land and about 12 per cent as not available for cultivation. These lands are of high relief, rocky/murmy, and unproductive.

Table 4.4: Land Use in the Villages in the Panshet Catchment Area

Village	(Area in Hectare)				
	Total village land	Forest department	Grass land	Total cultivated area	Share of forest Land*
Panshet	38	9	29	-	23.68
Kuravati	64	50	11	2.7	78.13
Ambegaon khurd	301	116	55	130.0	38.53
Dhindli	56	32	12	5.0	57.14
Kadve	702	203	235	68.3	28.91
Vadghar	339	52	231	45.0	15.33
Ambegaon budruk	486	68	258	25.0	13.99
Zone I	1986	530	831	276.0	
Gholapghar	98	23	45	29.4	23.46
Kambegi	153	42	74	25.0	27.45
Koshimghar	93	32	37	23.5	34.40
Bhalawadi	182	63	104	15.0	36.61
Givashi	311	62	157	26.0	19.93
Shirkoli	1257	260	811	57.0	20.68
Ghodshet	89	18	31	6.0	20.22
Thangaon	225	63	106	17.0	27.99
Zone II	2408	563	1365	198.9	
Chikhali khurd	85	48	35	13.0	56.47
Kasedi	176	54	49	51.6	30.68
Ghodkhal	316	89	154	72.8	28.16
Gondekhal	407	182	169	51.0	44.71
Pole	736	227	441	23.0	30.84
Mangaon	1016	300	449	122.6	29.52
Zone III	2736	900	1297	334.0	
Tekpole	966	325	402	77.0	33.64
Kurtawadi	549	235	163	75.0	42.80
Dapsare	833	248	355	84.0	29.77
Zone IV	2348	808	920	236.0	
Grand total	9478	2801	4413	1044.9	

* Forest Department Area as percentage of total village area

Agriculture: The families in the Panshet catchment area have now very limited cultivable land at their disposal. The rice lands which earlier extended over some 700 hectares are now restricted to only about 177 hectares and in some of the villages like Dhindli, Ghodshet, Kasedi, there is almost no land available for permanent cultivation. The families have to depend mainly on shifting cultivation for their livelihood. Over 80 per cent of the cultivated land is under shifting cultivation. (Table 4.5) The usual practice is to cultivate nachani (Eleusine coracana) in the 1st year when the plot is cleared for shifting cultivation. This is usually followed by vari (Panicum miliaceum) in the second year. Sawa (Panicum miliare), rala (Setaria italica), til or karale (Guizotia abyssinica) etc. are grown in the 2nd or the 3rd year in some villages. These crops occupy only a small area. (Fig. 4.3) There are some variations in the crops grown and the crop sequence in the different zones according to the soil and rainfall. Only about 10 per cent of the cultivated land is put to oilseeds like karale (cultivated usually in third year). The agro-climatic conditions thus permit cultivation of only a few crops. After the third year, the lands are left fallow for the regeneration of vegetation, the length of fallow period varies according to the availability of land. In the 1st zone much of the culturable land got submerged and the cultivated land works to only about .4 hectare per household. Because of



16. Preparing Field for Paddy



17. Transplanting Paddy



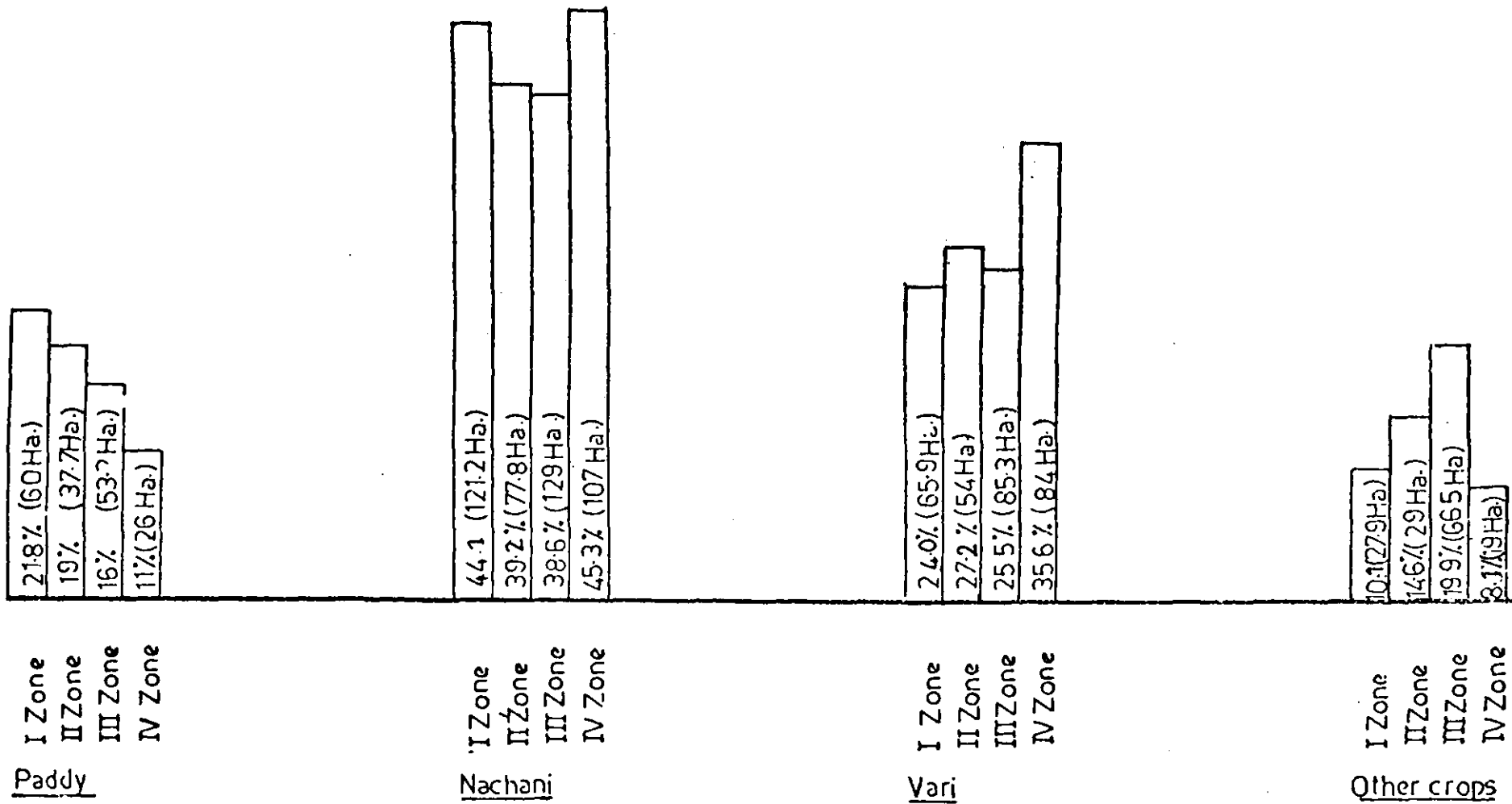
18. Paddy Straw Stored on Raised Platform

Table 4.5: Cropping Pattern in the Villages
in the Panshet Catchment Area (1983)

Village	(Area in Hectare)				
	Total cultivated area	Rice	Nachani	Vari	Other crops
Panshet	-	-	-	-	-
Kuravati	2.7	-	1.2	0.7	0.8
Ambegaon khurd	130.0	10.0	50.0	55.0	15.0
Dhindli	5.0	1.0	2.0	1.0	1.0
Kadve	68.3	35.0	26.0	1.2	6.1
Vadghar	45.0	10.0	28.0	4.0	3.0
Ambegaon budruk	25.0	4.0	15.0	4.0	2.0
Zone I	276.0	60.0	122.2	65.9	27.9
Gholapghar	29.4	0.4	10.0	15.0	4.0
Kambegi	25.0	3.4	7.6	9.0	5.0
Koshimghar	23.5	5.6	10.5	5.0	2.4
Bhalawadi	15.0	5.3	5.7	2.0	2.0
Givashi	26.0	4.0	15.0	4.0	3.0
Shirkoli	57.0	14.0	24.0	15.0	4.0
Ghodshet	6.0	1.0	3.0	2.0	-
Thangaon	17.0	4.0	2.0	2.0	9.0
Zone II	198.9	37.7	77.8	54.0	29.4
Chikhali khurd	13.0	0.8	6.0	1.3	4.9
Kasedi	51.6	16.6	18.0	10.0	7.0
Ghodkhal	72.8	12.8	30.0	13.0	17.0
Gondekhal	51.0	5.0	20.0	15.0	11.0
Pole	23.0	4.0	11.0	5.0	3.0
Mangaon	122.6	14.0	44.0	41.0	23.6
Zone III	334.0	53.2	129.0	85.3	66.5
Takepole	77.0	15.0	32.0	28.0	2.0
Kurtawadi	75.0	5.0	42.0	25.0	3.0
Dapsare	84.0	6.0	33.0	31.0	14.0
Zone IV	236.0	26.0	107.0	84.0	19.0
Grand total	1044.9	176.9	436.0	289.2	142.8

Fig 4-3

PANSHET CATCHMENT : CROP PATTERN



the paucity of land the fallow period has got shortened. It is as short as 3 years in a village like Kuravati. In the IInd zone the average cultivated area per family, came to one hectare and the average is noted to be 1.5 hectares in the IIIrd zone. The fallow period varied from 5 to 12 years in these zones.

The above refers only to the land under private ownership and recorded as under cultivation in the village records. However the land available being inadequate particularly in the 1st zone, there is encroachment on the forest lands which any way are now reduced almost to grasslands. The Dhangar families also have very limited lands and encroachment on forest lands is frequent. Taking into consideration the estimated encroached land, the land under shifting cultivation in a particular year worked to about 11 per cent of the total land (excluding the land under permanent cultivation).

7. Shifting Cultivation:

Shifting cultivation is very labour intensive. It involves cutting of the trees and brushwood on the slopy lands. These operations are carried on in April-May. The larger logs are used as timber or for charcoal making while the smaller branches and brushwood are left to dry for a couple of weeks. They are heaped at 5-6 places in the plot where seedbeds are to be subsequently made. They are fired and the ash is mainly



19. Clearing Vegetation to Prepare the Field for Shifting Cultivation



20. Ploughing the Field for nachani

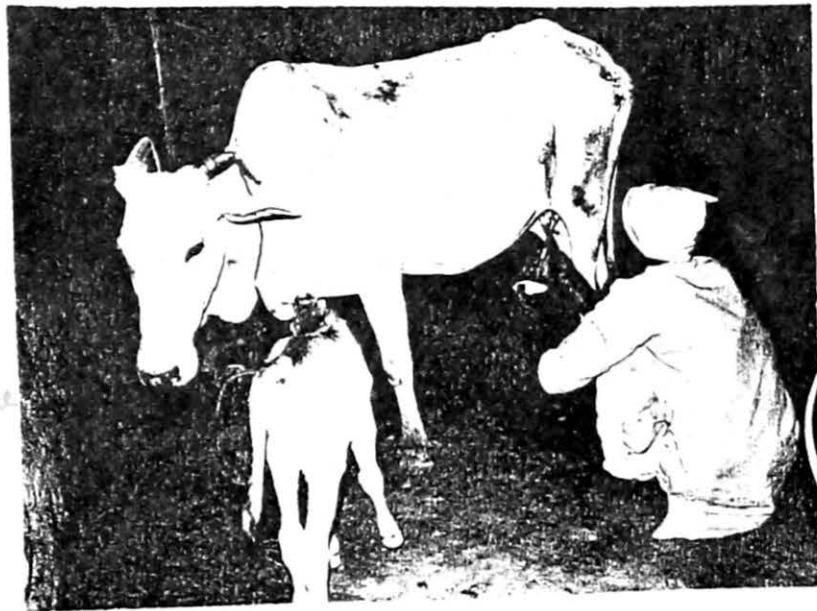


21. Replanting nachani by Throwing the Stalk into the Mud Prepared to receive it

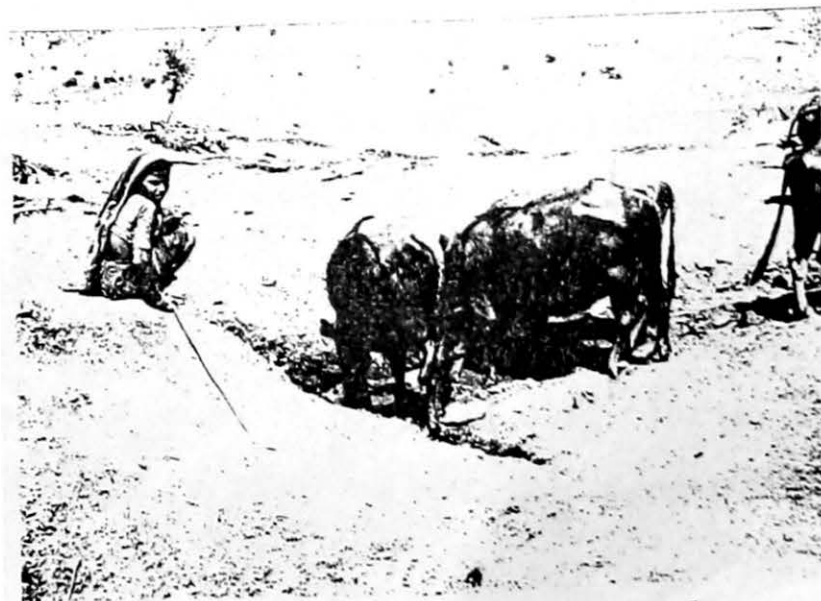
used for the seedbeds. After the 1st showers seed is sown in the seedbeds. The fields are ploughed with the help of a wooden plough drawn by two bullocks. About half of the peasant families owned a wooden plough. (Table 4.6) It is extremely arduous and time consuming to plough the steep sloping lands. After ploughing a man-drawn (2 persons) doinangar is used to make furrows in the field. The fields are prepared usually in the month of June and the seedlings are put in the furrows in late July or early August. Unlike paddy the seedlings are not planted but are just placed in the furrow in transplanting nachani and in the case of vari these are just broadcast in the field. Subsequently the ferns and shrub growth in the plot are thrashed down. Weeding is the next labour intensive operation carried out (generally twice or thrice) in August-September. Weeds are plentiful in this heavy rainfall tract. Harvesting is done manually in the month November with the help of a sickle and the plants are left to dry. Threshing is done in December with the help of bullocks. Bullocks are thus used only for ploughing, levelling (in the case of rice fields) and threshing and it was noted that the number of bullock days of work per hectare were 6 to 8 days for ploughing and 30 days for threshing. The rest of the time the bullocks have hardly any work. They cannot be used for transportation because of the nature of terrain. A pair of bullocks is however essential for cultivation and the families maintained a pair



22. Threshing nachani



23. Milking



24. Tending Buffalo

though it was grossly under utilized. The average number of days of work came only to about 50-60 days in a year. Because of the very labour intensive nature of shifting cultivation it is not possible in a given season to bring under plough more than one or 1.5 hectare of land per household, drawing primarily upon the family labour. Since an individual family finds it very arduous to complete the operations single handedly the usual practice is to work in a team. About 6 to 8 families join together and pool their labour and bullock power and operate the land jointly. The land is at times taken on lease. Even a landless family can join the team. Details of the manpower and bullock power needed were collected from a team (of six households) in 1984 cultivating nachani crop jointly; the data are presented in Table 4.7.

About 330 mandays of work were needed for the production of one tonne of nachani. In addition to the labour contribution by the cultivating families certain cash expenditure is also involved. There are certain operations like weeding, which have to be completed on time. Hence the villagers resort to hataraki. All the adult workers from the village join the hataraki team and work together on a specific plot under nachani. The owner on whose land the team is working pays them Re. 1 per head and two meals per working day. The team of six got weeding operations done on hataraki basis three times during the season and this involved a cash expenditure

Table 4.6: Proportion of Families Reporting Ownership of Plough, Harrow and Large Field Hoe

	Percentage of families* reporting ownership of		
	Plough (<u>Nangar</u>)	Harrow (<u>Kulava</u>)	Large Field Hoe (<u>Petari</u>)
Zone I	45	42	44
Zone II	70	54	48
Zone III	53	43	48
Zone IV	61	61	54
Total families	62	49	58

* Refers to families covered in the survey from the main villages; does not include Gavli Dhangar families

Table 4.7: Manpower Utilization for Nachani Cultivation

Operation	No. of work days per Ha.	Per cent
Felling of trees/shrubs	18	8.1
Firing the plot	8	3.6
Ploughing & clearing the plot	20	9.0
Sowing	7	3.1
Transplanting	13	5.8
Crushing down ferns	4	1.8
Weeding (3 times)	82	36.8
Harvesting	33	14.8
Threshing	38	17.0
Total	223	100.0

Note: A team of six cultivating households operated about six hectares of land jointly using their family labour; only for weeding operations there were in addition about 55 workers who joined the team, on hataraki basis for one day, three times in the season to complete the weeding work expeditiously.

of about Rs. 175 per tonne of nachani. In addition at the time of starting each operation religious rites are performed offering coconut, chicken/goat to the deity; the cash expenditure involved on this account amounted to Rs.125/- per tonne. One has also to take into account the investment in agricultural implements, maintenance of bullocks and rent if the land is leased in. The rents are usually paid in kind that amount to about 12 to 15 per cent of the total produce. The cultivation of nachani does not even yield the cost of family labour, but the peasants resort to it for want of any alternative work opportunity during the monsoon season and to make provision for the cereal requirements of the family.

In contrast, it is noted that the cereal cultivation in the plains in Western Maharashtra involves about 100 mandays of work per tonne of bajra and 80 mandays per tonne of jowar. (Brahme, 1975) In the plains, in the Deccan, a pair of bullock is maintained per 4 to 6 hectares of land, whereas in the hilly tracts of Panshet catchment area it was noted that there was, at least, one bullock per hectare and in some villages as many as 4 bullocks per hectare. (Table 4.8) On an average it worked to 2-3 bullocks per hectare in the 1st and 2nd zones and about 1 bullock per hectare in the third and fourth zones. As noted above a family is in a position to cultivate only about one hectare of land and needs one pair of bullock for this purpose. Consequently a large bullock

Table 4.8: Livestock Population in the
Panshet Catchment Area (1982)

Village	Bullocks	B/Ha	Cows	She buffalo	Sheep	Goat	Poultry
Panshet	25	na	36	-	-	-	-
Kuravati	20	n	14	6	-	-	30
Ambegaon khurd	126	1	139	35	170	137	379
Dhindli	20	4	14	27	-	22	86
Kadve	165	2	120	146	36	58	325
Vadghar	125	3	156	46	-	91	395
Ambegaon budruk	70	3	95	39	-	-	134
Zone I	551		574	299	206	308	1349
Gholapghar	na	na	na	na	na	na	na
Kambegi	37	1	36	9	-	16	136
Koshimghar	49	2	43	30	-	-	230
Bhalawadi	na	na	na	na	na	na	na
Givashi	102	4	149	58	-	151	366
Shirkoli	189	3	226	68	-	130	501
Ghodshet	23	4	11	4	17	11	67
Thangaon	69	4	71	22	32	74	131
Zone II	469		536	191	49	382	1431
Chikhali khurd	16	1	18	17	24	-	119
Kasedi	77	1	123	33	-	-	202
Ghodkhal	52	1	67	33	-	-	145
Gondekhal	67	1	112	33	-	-	207
Pole	102	4	93	30	-	120	259
Mangaon	103	1	146	28	-	116	261
Zone III	417		559	174	24	236	1193
Tekpole	137	2	278	49	-	-	385
Kurtawadi	34	a	46	9	-	-	97
Dapsare	67	1	98	45	-	-	285
Zone IV	238		422	103	-	-	767
Grand total	1675		2091	767	279	926	4740

na - not available

a - less than one

n - no or negligible cultivated land

B/Ha - approximate no. of bullocks per hectare

population in relation to the land cultivated is maintained. The bullocks are usually obtained from the homestock and the maintenance of bullocks does not involve any cash expenditure as the grazing grounds are free. However, as will be noted in the following section the grazing grounds are not adequate to sustain the cattle population existing in the catchment area. As a result of overgrazing the resource base is deteriorating and the lack of adequate grazing grounds means that the cattle is underfed and poor.

8. Crop Production:

The crop growth in this tract is restricted due to leaching of mineral nutrients and growth of deep-rooted fire tolerant varieties of weeds. Many families do not apply any manure or fertilizer and the amount if applied is small. The dung used as manure is usually applied to the rice fields. Even though the number of cattle is large it is very poorly fed so that the dung yield is not high. Part of the dung is lost as cattle grazes around, and because Dung is also used for making dung-cakes. The torrential rains wash away the upper layers of good soil and manure/fertilizer. As noted earlier it was difficult to estimate the production per hectare as the plots are of very irregular size. The productivity varied from plot to plot. The estimated productivity of nachani ranged between 5 to 8 quintals per hectare, that of vari from 3 to 6

quintals and that of karale from .5 to 1.5 quintals, per hectare.

Apart from the cereals and oilseeds like karale, certain lentils and vegetables are grown in the rainy season on the field border and in the parda (the yard around the house). The main lentils grown are pawata (Dolichos lablab) masoor (Lens esculenta) and gram (Cicer arietinum). Creepers of cucumber, red pumphin and white gourd and leafy vegetables like math, rajqira, chilli, egg-plant, tubers like sweet potato are grown. In addition a number of vegetables like ghotwel, takla, tubers of ranalu, halunda, alukanda and mushrooms growing wild in the monsoon season are also used. The important edible plants are shown in Table 4.9. Many of the families have a few valuable trees like Mango, Jackfruit, Bamboo in the parda and the fruit is sold in the market depending upon the transport facility. The villagers upto Shirkoli on the south bank and upto Koshimghar on the north bank are able to transport the fruit (even on foot) while marketing is not possible for those in the interior villages of zone III and IV.

The fruit is usually collected by the owners and carried to the wholesale market in Pune. At times the fruit is sold to the merchants from Pune on a per tree basis for a lump-sum and the merchants arrange to pluck the fruit and its sale. Apta and Hirda trees are auctioned out by the forest department and the contractors employ the local labour for the

Table 4 9

Edible wild plants in Panshet Catchment Area

Local name	Botanical name	Habit	Edible part
Aloo	<u>Meynea laxiflora</u>	S	F
Alimb	<u>Agaricus</u> Sp	M	M
Angul	<u>Elaeagnus conferta</u>	S	F
Avla	<u>Emblica officinalis</u>	St	F
Chaeen	<u>Ensete superbum</u>	H	F, In
Barka	<u>Smithia conferta</u>	H	L
Bharangi	<u>Clerodendrum serratum</u>	S	Fl
Bhokar	<u>Cordia dichotoma</u>	T	L
Chicharti	<u>Solanum indicum</u>	S	F
Gholu	<u>Portulaca oleracea</u>	H	L
Ghotvel	<u>Smilax zeylanica</u>	C	B, L
Halunda	<u>Vigna capensis</u>	C	R, S
Jambul	<u>Syzygium cumini</u>	T	F

Local name	Botanical name	Habit	Edible part
Kala kuda	<u>Wrightia tinctoria</u>	St	Fl
Kantemath	<u>Amaranthus spinosus</u>	H	L
Karvand	<u>Carissa congesta</u>	S	F
—	<u>Ceropegia tuberosa</u>	C	T
Kharpudi	<u>Ceropegia lawii</u>	H	T
Kurdu	<u>Celosia argentea</u>	H	L
Kusar	<u>Jasminum malabaricum</u>	S	F
Makađ limbu	<u>Atalantia racemosa</u>	St	F
Mango	<u>Mangifera indica</u>	T	F
Meki	<u>Cucumis melo</u>	C	F
Nichardi	<u>Indigofera pulchella</u>	S	Fl, Fb.
Ranmug	<u>Phaseolus radiatus</u>	H	S
Ran Shevga	<u>Phaseolus khandalensis</u>	H	S
Shendwel	<u>Dioscorea pentaphylla</u>	C	Fb
Shindi	<u>Phoenix sylvestris</u>	T	F

Local name	Botanical name	Habit	Edible part
Takmak	<u>Cucumis melo</u>	C	F
Takla	<u>Cassia tora</u>	H	L
Toran	<u>Zizyphus rugosa</u>	S	F

Habit
H - Herb
S - Shrub
St - Small tree
T - Tall tree
C - Climber
M - Mushroom

Edible part
L - Leaves
Fb - Flower buds
Fl - Flowers
In - Inflorescence
F - Fruits
S - Seeds
B - Branches
R - Root
T - Tuber
M - Mushroom

collection of leaves/fruit. For the last two years there was no collection of Hirda; the prices were so low that it was uneconomic to collect it.

9. Sale of Bamboo and Trees:

The peasants also sell bamboo and in cases of contingency sell mature trees. The merchants/contractors from Pune usually buy clumps of bamboo or trees and arrange for felling the tree and its transport etc. It was estimated that depending upon the size, bamboo fetches Rs.2 to Rs.5 per piece, while kalak about .5 to Re.1 per piece. The value of tree depends upon the species and the size. The approximate return on a full grown mature mango tree was reported to be Rs.1500. Ain, Hirda fetched about Rs.800 to 1000. Coal merchants from Pune also operate in the region. They often buy the plots which are to be clear-felled for shifting cultivation and the payment is usually made on the basis of amount of charcoal produced. (The rate in 1984 was noted to be Rs.6 per bag of charcoal or 20 paisas per kg. of charcoal made.)

10. Milk Production:

The other important economic activity is the upkeep of the cattle. As noted above bullocks are needed by the peasant and Dhangar households for ploughing purpose. The bullocks are obtained from the homestock for which purpose cows are maintained. The cattle is of local breed, that which can survive and work in the adverse conditions - heavy



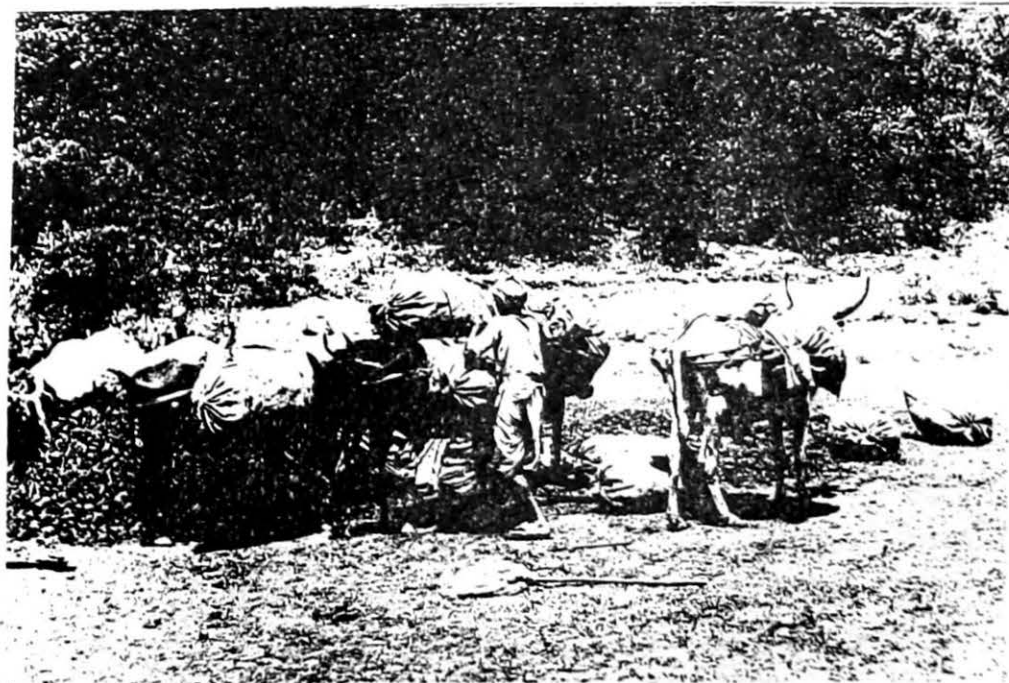
25. Katkari Selling Fish



Carrying Headload of brushwood



27 Tree Hacked for Charcoal-making



28. Transporting Charcoal

rainfall, paucity of fodder, difficult terrain etc. As the grazing grounds are extensive (though the grass available is of poor quality and there is a severe shortage of grass in the summer months) there is a tendency to maintain bullocks and cows even after they are no more useful. It was reported that the animals, particularly the older ones often meet with accidents, break a leg and subsequently succumb. Mortality was reportedly high during the rainy season. Since the peasants do not have the means to buy the cattle, they try to maintain all the animals from the home-grown stock. Market for milk was not developed before the 'fifties as there was no motorable road. The villagers from a few nearby villages brought milk to Panshet and delivered it to a private dairy-man from Vinzar. It was only after the reservoir was filled up that a launch service was organized by the Pune district milk producers' cooperative society to collect the milk from the catchment area. The launch starts from Panshet township around 3.30 a.m. in the flush season (when the lake is full it can reach villages upto Tekpole) to collect the milk cans and reaches Panshet between 8.30 to 9.00 a.m. In summer as the water level recedes, launch can reach only upto Shirkoli. The milk supply is also quite limited in this season. Milk is transported in vans from Panshet to the milk processing plant in Pune. Sale of milk is an important source of cash income and the peasants and the Dhangars sell as much milk as possible. As a result the

home consumption of milk and particularly of butter-milk (since milk could not be sold formerly it was curdled, butter was separated and converted to ghee for sale and the buttermilk was consumed by the family) has been drastically reduced. It was also reported that in order to sell larger quantity of milk calves are often left half starved; this adversely affects their growth and maturity.

The cattle depends mainly on grazing for its feed. The grazing grounds are poor and overgrazed. There is a shortage of grass in summer. The cattle is thus undernourished. The usual practice is to cut and store some grass in December-January which is used in May-June-July. After the break of monsoon in June the grasses sprout and by mid-July the grazing season begins. The peasants have to attend the cattle till December or so, as the crops are in the field and some grass plots preserved for hay-making are to be protected. The cattle is left to find its own feed after January and the times are quite hard till July.

The flush season for milk begins in August and lasts till February. From March to July there is little milk production in any of the villages in the catchment area, except for the two villages viz., Kadve and Vadghar which are located near the valley region and there is a better grass-supply. (Table 4.10) These two villages are located near Panshet and can deliver milk at Panshet even if there is no

Table 4.10: Milk Collection by the Poona Cooperative Milk Federation from Panshet Catchment Area (1984)

Month	Milk in lit.s per month (1984)		
	All villages	Kadve	Vadghar
January	18235	5871	1275
February	10898	4260	2197
March	4563	3082	1093
April	3877	3304	573
May	3192	2035	776
June	3839	1654	835
July	4096	2220	1004
August	12100	5111	1939
September	28530	8444	3660
October	35853	10391	3909
November	30214	8790	3421
December	18422	5262	2441
Total	173819	60424	23123

launch service due to breakdown of the launch or rough weather. In such a case the villagers in the interior are not able to deliver the milk to the cooperative. The daily milk yield of a cow was noted to be about 2 lit.s after calving and is reduced to about half a lit. towards the end of the lactation period. Averaged over the lactation period the daily milk yield comes to one lit., and the total milk production per lactation varies between 150 to 200 lit. In the total cow population about 35 per cent of the cows were in milk.

Buffaloes are maintained as milch animals mainly by the Dhangars. Some peasant families also reported buffaloes. The average daily milk yield was about 2 to 3 lit.s in the case of buffalo and the total milk production during the lactation period varied from 500 to 600 lit.s. The buffalo milk also fetched a better price as the fat content is higher. The average price received per lit. of milk was reported to be Rs. 2.5. The sale of milk in the year 1984 yielded an income of about Rs. 4.5 lakh.

11. Wage Employment:

The agricultural operations are over by December; the cattle does not need any tending after January. Peasants have no work for about four to five months, i.e. till May and no source of income till the monsoon crop is harvested except for some sale of milk that begins from August. The need for

gainful work in the lean months is widespread in most parts of Maharashtra and since early 'seventies pressure on the Government has been increasing to provide gainful work. Consequently the Maharashtra Government introduced a scheme of Employment Guarantee under which road works, bunding works, tank works etc., are opened up in January-February and these continue till about May. It is stipulated that EGS works should not be operative during the season of agricultural work. The Government has stipulated certain wage rates for the irrigated and dry tracts of the state. But the actual wage rates vary with the economic condition of the region and the organisational strength of the workers. Panshet catchment region is quite poor and the labour is unorganized. Consequently the wage level is relatively low. In 1984 it was reported to be Rs.6 to Rs.7 per day for men and Rs. 4 to 5 per day for women. The main work opened up in this tract is the road work. Kaccha road built from Panshet to reach the villages in the catchment area has to be repaired every year, (as parts get washed by the torrential rains). There is thus routine annual repair works on kaccha road. The wage rates on PWD and other construction works at Panshet are better (Rs.10 for men and Rs.8 for women). The villagers staying within 5/6 km. of Panshet township can walk up to Panshet and work there. For the rest, road work under EGS is the only means for survival through the summer months. Nearly all the women join the road works opened up under the EGS while some

29. At Employment Gaurantee
Scheme Road Work



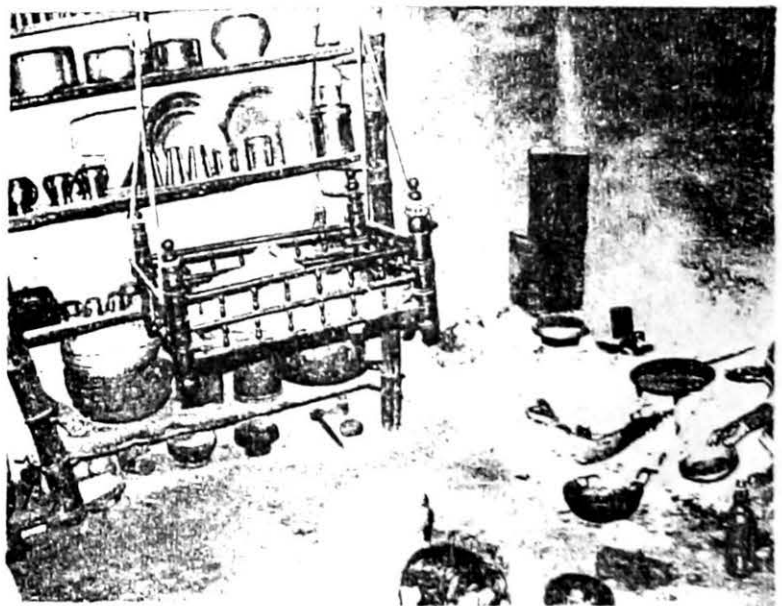
30. Grinding vari



31 Husking Paddy with pestle



32. In the Kitchen



clothing etc., was brought when they visited the family.

12. Work Schedule:

All the adults - males and females were working, the men spending the entire time in agriculture, tending cattle, wage work etc., while the women spent a major part of their time in domestic chores.

Table 4.11: Work Schedule of Women

Type of work	Family A hours per day	Family B hours per day
Cooking	4	3
Grinding	2	1
Fetching water	2	1.5
Cleaning cattle pens	1	1
Washing clothes - cleaning utensils	1	1
Collecting fuel	2	-

Note: Family A had seven members (4 adults and 3 children), the 2 women shared the responsibility of domestic work, Family B had 2 adult men, 1 adult woman and three children, the men helped in collecting fuel.

Women spent on an average 6 to 8 hours in household chores and about 5 to 6 hours in agriculture or wage work. If there was no grown up child in the family, they had also



33. Fetching Water from the Lake



34. A Six-year Girl Looking After Her Younger Sibling



35. Stitching Patched Bed-sheet Using Old Sarees

to look after their young children, apart from the responsibility of feeding and bathing the young children. In collection of fuelwood children and men helped. The work of cutting grass/fodder was shared by men/women. Cleaning the cattlepen and making dung cakes was women's duty, while milking was usually the men's. Young children, particularly boys tended the cattle; if there were no grown up children (about 7-8 years) in the family then the women or men attended this work. Fetching water was noted to be women's responsibility in about 60 per cent of the families and it was shared by men-women in the rest of the families.

The main tasks that men undertook were felling of trees/bamboos, clearing of plot for shifting cultivation, ploughing, sowing, weeding, harvesting and threshing, milking and delivery of milk and wage work. The women worked in clearing the plots, sowing, weeding, transplanting, harvesting, transporting, carrying headload of fuelwood for sale to Panshet and wage work.

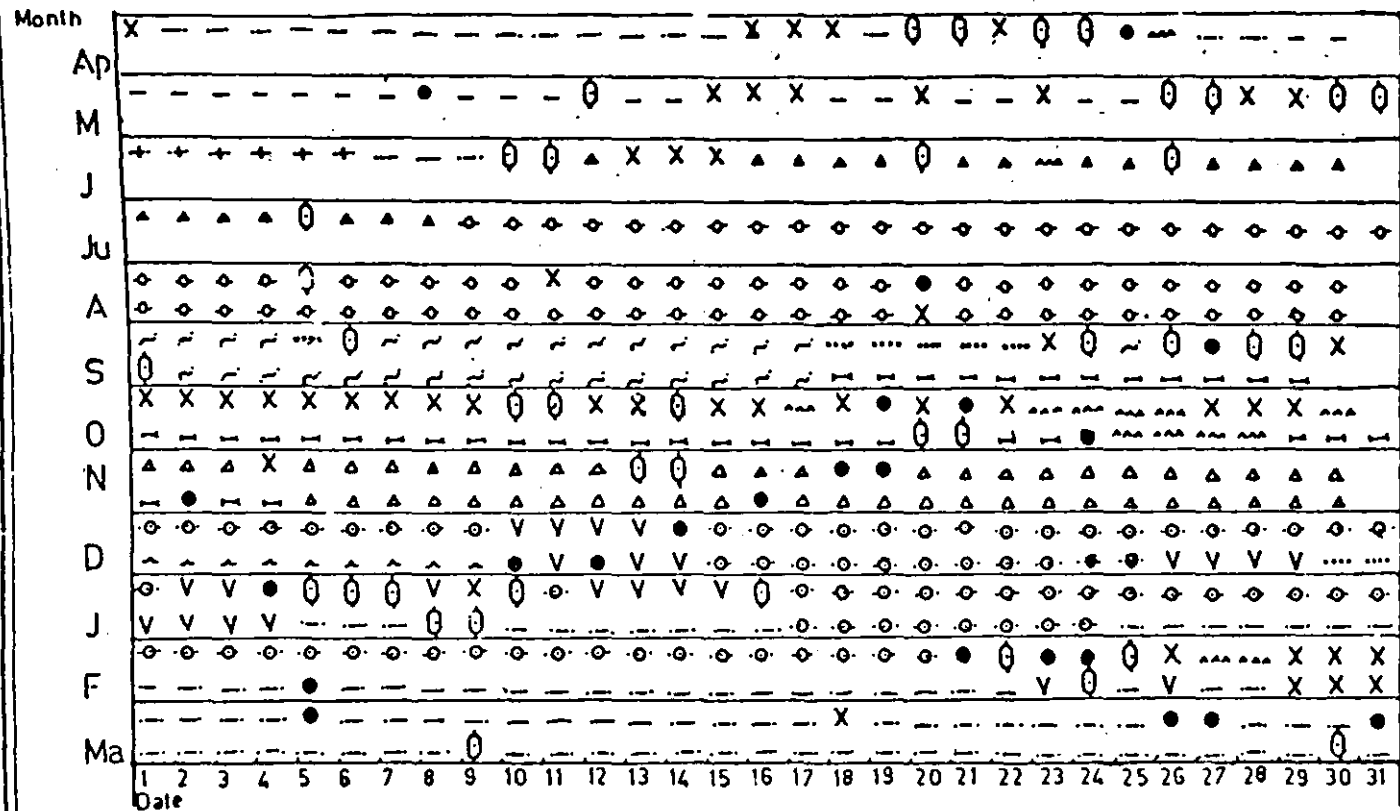
A few families from Shirkoli were requested to maintain daily record of the work done. Data from two families that maintained the record very carefully, one being a larger family with about 8 hectares of land and the other with about 2 hectares of land are presented here to get a broad picture of the work-pattern. The record was maintained for the period September 1984 to August 1985.

In family A, one son, aged 26 was in the Postal service and helped only occasionally when there was some urgent agricultural work to be completed. The son aged 17 looked after the cattle. The women helped in agricultural operations like transplanting, weeding, harvesting when considerable labour power was needed. One woman was mainly occupied with the responsibility of the three young children and the two others shared the house-work. The head of the family aged 55 was fully occupied with agricultural work and in summer with charcoal making. One son helped in agricultural operations and in making charcoal, he however set up a separate establishment from April 1985. Details of the work schedule of family A & B are presented in figures 4.4 to 4.6. Excepting October, in which there was almost no work, the head was engaged in agricultural operations from June till February, and felling of trees and making charcoal in March-April. There was no work for about 11 per cent of the days in the year and he was out of station for personal or other work for 14 per cent of the days. The work pattern of his son is similar. The distribution of the work hours put in by the entire family is presented in Table 4.12 by the type of work. About 10 per cent of the work hours were spent in preparatory tillage and sowing, 18 per cent in weeding which is quite heavy for nachani, 10 per cent in harvesting and 10 per cent in threshing, 10 per cent in tending cattle, 15 per cent in cutting grass. The

Fig. 44

ANNUAL WORK PATTERN-FAMILY-A

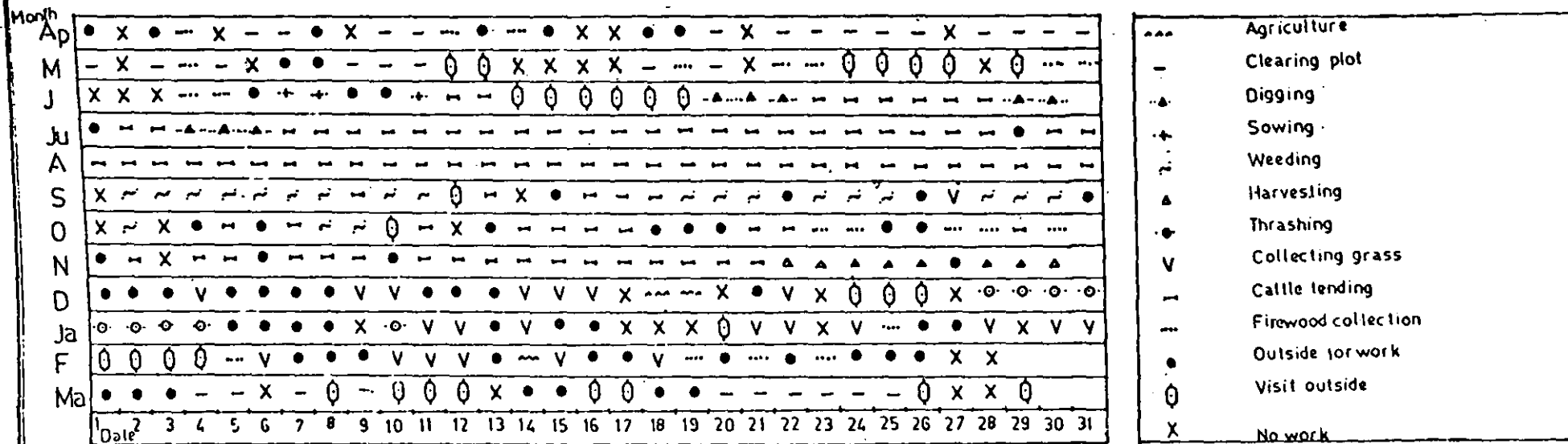
F : Father
S : Son



- △△△ Agriculture
- Clearing plot
- △ Ploughing
- +
- Transplantation
- Weeding
- △ Harvesting
- Thrashing
- V Collecting grass
- △△△ Firewood collection
- Cattle tending
- Tree felling
- Out side for work
- Visit outside
- △ Making bundles
- X No work

Fig. 4.6

ANNUAL WORK PATTERN: FAMILY-B - SON



- △△△ Agriculture
- Clearing plot
- △ Digging
- + Sowing
- ~ Weeding
- △ Harvesting
- Threshing
- v Collecting grass
- Cattle tending
- Firewood collection
- Outside for work
- ⊙ Visit outside
- x No work

Table 4.12: Percentage Distribution of Work Hours in a Year According to Type of Work

Type of work	Family		
	A	B	C
Ploughing	3.4	6.6	2.5
Planting Nachani	3.2	5.1	2.5
" Vari	2.4	1.2	.5
" Rice	0.6	5.0	2.6
Weeding Nachani	15.8	13.4	10.0
" Vari	1.6	2.6	.4
" Rice	0.2	1.4	.1
Harvesting Nachani	5.9	4.7	3.6
" Vari	2.8	2.0	.2
" Rice	1.6	2.4	.1
Threshing Nachani	9.5	13.0	7.1
" Vari	0.5	0.5	.5
Other agricultural operations	3.0	1.0	9.2
Collecting grass/fodder	5.2	7.4	5.4
Collecting fuelwood	2.6	1.6	1.5
Milk Delivery	2.5	5.9	-
Tending cattle	10.0	21.9	15.4
Felling trees	10.0	-	-
Making charcoal	5.5	-	-
Wage work	13.7	4.3	38.9
	100.0	100.0	100.0

Table 4.13: Seasonal Pattern in Vegetable Consumption

Vegetable	Month											
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Leafy vegetables		*	*	*	*							
White gourd			*	*	*							
Bean				*	*	*	*					
<u>Pawta</u>							*	*				
Mushroom		*	*									
<u>Shendwel ghotwel</u>		*	*	*								
Pumpkin				*	*	*						
Cucumber			*	*	*							
Egg plant					*	*	*	*	*			
<u>Chicharti</u>								*	*	*		
Onion										*	*	*
Potato	*							*	*	*	*	*

* Indicates consumption of particular vegetable in that month.

total work time spent in agricultural operation, cattle tending and milk business, charcoal making and other labour was 50.5 per cent, 17.7 per cent, 15.5 per cent and 13.6 per cent respectively.

In family B the head of the family was engaged in cultivation, one son helped him while the other son looked after the cattle. The women helped during the busy season. As the land owned by family B is only about 2 hectares the family did not have any possibility of cutting trees for making charcoal. No work was available in March/April and the number of days without work was considerably more. About 40 per cent of the days were without work for the head. More time, about 35 per cent of the work hours of the family were spent in cattle tending and milk business and almost 60 per cent of the work hours were spent in agricultural work. The family does not have any opportunity for diversification of work. The head of the family stated that the small size of holding and the lack of work during the summer months makes it impossible to meet even the subsistence needs of the family. One of the sons from family B has moved to Bombay because of this hardship. He has moved with his family and is not in a position to help his parents in Shirkoli.

Such is the plight of a large number of families; the loss of land due to the construction of dam has eroded the

economic base of many families and pushed them below the poverty line.

13. Aggregate Production and Income:

Attempt is made to estimate the agricultural and other production on the basis of the averages of productivity worked out with the help of the survey data and records. The estimation of forest produce is derived using the data on tree composition and average yields as the families were not able to provide information regarding the quantity of forest produce collected and sold and collected for home consumption. Estimation of milk production is based on the data on sales to the cooperative society, other sales, and the reported home consumption figures. The fuelwood consumption is estimated on the basis of the data obtained through the family schedule. As regards the sale of trees for timber, charcoal making and sale of fuelwood, the villagers were reluctant to supply information in this regards. The merchants and contractors dealing in charcoal, timber etc., refused to give any information regarding their business. As the study area is accessible only by one route - via Panshet township, attempt was made through field observation to note the movement of these products. A crude estimate is worked out on the basis of this information. The estimates are made to get a broad picture of the magnitudes involved and are not exact because of a variety of data gaps and problems faced while working out the estimates.

Information on the prices of sale of tree or bamboo were obtained from the farmers. Fruit was generally sold in the wholesale market at Pune and the farmers supplied the information relating to market prices. Imputation of values of the produce not sold e.g. nachani, vari, pawata, vegetables grown in the field and in parda, eggs, chicken, meat, milk from own poultry, livestock, fuelwood and fruit collected from the forest, posed a problem. Notional prices were used taking into consideration the market prices and the transport and marketing costs. The estimated value of cereal production for the entire region (24 villages) was about Rs. 20 lakh and that of other production viz., oilseeds, lentils, vegetables, fruit, milk, eggs etc., was about Rs.3.5 lakh. In addition fuelwood worth Rs.4 lakh was used for cooking/heating water. Grazing was also free and the value of grass grazed worked out on the basis of the number of livestock and average consumption of grass came to Rs. 2 lakh.

Except for rice a small proportion of which was marketed, no other agricultural produce was sold. Major production of milk was sold excepting on occasions when the launch service was not available. Livestock was at times sold mainly to meet some contingency. Some brushwood was collected and carried as headload over a distance of about 8 to 10 km.s and sold at the Panshet township. A headload fetched about Rs. 6 to Rs. 7 in the Panshet market. Bamboo, fruit like Mango,

Jackfruit grown in parda and karvand, aloo, apta leaves etc., collected from the forest, honey collected were the other marketed products. Standing trees are usually sold for charcoal making when a plot is to be clear-felled for shifting cultivation. In addition mature trees are sold for timber in cases of contingency. The estimated value of trees and bamboos sold came to Rs.3.0 lakh, that of milk 4.56 lakh, that of fruit Rs. 2.0 lakh and the value of other produce e.g. fuelwood, apta leaves, agricultural produce, honey, vegetables etc. sold was estimated at Rs. 1.5 lakh.

There were a few members employed in the salaried service - as postman, teacher, village level workers etc.; some workers worked in Panshet and a large number worked seasonally on the EGS works. The estimated earnings from these sources were Rs. 7.50 lakh and the value of incomings in terms of cash remittances and agricultural produce (self-production or rent) from the families living in the Daund taluka was estimated to be Rs. 1.5 lakh. In terms of resources used about 44 per cent of the total earnings came from land cultivation, about 27 per cent from forest resources, about 11 per cent from livestock and 18 per cent from outside the local economy in terms of salaries, wages and remittances.

In addition, the bamboo and timber locally available is used for making agricultural implements and for house

construction. Timber from trees like Hirda, Ain, Limbara, Anjan, Nana, Asana is suited for making agricultural implements and timber from trees like Ain, Chandada, Dhawda, Jambhool and bamboo is used in house construction. Most of the houses have thatched roof and grasses like kolim or karvi, locally available are used for this purpose. The inhabitants are thus dependent on the local resources for most of the basic needs. This entails high labour expenditure but provides only a bare subsistence, because the resource base is poor, over-exploited and fast deteriorating.

14. Consumption:

The staple food of the people is bhakari usually of nachani which is the main cereal crop of the region. It is supplemented by bhat made of rice or bhagar made of vari. A kalwan is prepared using some vegetables seasonally available; or of lentils like chavali, mataki, pawata, masoor, hulqa or pulses like tur, moog, gram, udid etc. At times kalwan is made using crab, egg, chicken, mutton, or dry fish. Tea is common, milk is added to tea when available. Consumption of milk/butter-milk depends on the supply of the same from own cattle. In summer almost no milk is available. A variety of vegetables according to season are used. Beans, leafy vegetables, red pumpkin, gourd, cucumber, egg plant etc., grow in parda or on fence while some leafy vegetables and tubers are obtained from the forest. (Table 4.13) No vegetables are locally available

in summer when potato, onions are used. Information on the quantity of bhakar, bhat, kalwan etc., daily consumed was sought from the surveyed families. The estimated consumption per day per adult is shown in Table 4.14. Calories are obtained mainly from cereals and the diet is deficient in the intake of pulses, vegetables, milk and other animal products.

It was noted that about 80 per cent of the cereals and 60 per cent of the pulses consumed were obtained from home production and the corresponding proportion for vegetables was about 65 per cent. Milk, eggs, chicken, meat were also obtained from own livestock and poultry. In monsoon season, farmers reported angling of fish, at times young boys captured crabs, snared rabbits. Fish was also purchased locally from Bhois - a fisherman caste or Katkaris traditionally specialized in kat-making and charcoal making but who were also engaged in fishing. Dry fish was at times purchased from the market. The main items of purchase used in the daily diet were sugar, gur, cooking oil, tea, salt, chilli, spices; for occasional use tapioca, groundnut, coconut, garlic, rawa, sweets etc., were purchased. About 45 per cent of the items of food consumption were purchased.

Fuel: Brushwood collected from the fallow lands and forest patches is used for cooking and heating water. Brushwood supply comes mainly from common shrubs like karvi, karvand,

bhoma, rametha, lantana. It was reported that the villagers from zone I have to hunt over a wide area for brushwood needed for daily use and have to spend even 7 to 8 hours to collect and carry the brushwood to meet the needs of a couple of days. The traditional mud chula which has a low efficiency (about 10 per cent) is used for cooking food. The estimated consumption of brushwood worked out to about 2.2 tonnes per annum per average-size family.

Attempts to save fuelwood are being made through "Integrated Energy Systems" programme of the Poona University in Shirkoli. Solar cookers were distributed free of cost to some 25 families in Shirkoli in 1985. The families however did not find the cooker useful as it could be used only for cooking rice. The villagers opined that once the chula is fired it is convenient to complete all the cooking, making bhakar, kalwan, rice etc., than to depend on the solar cooker for one ~~item~~; besides it takes long time to cook and the cooker is also useless on a cloudy day. The families prepare the meal early in the morning and go to work and the time schedule of the solar cooker is not convenient.

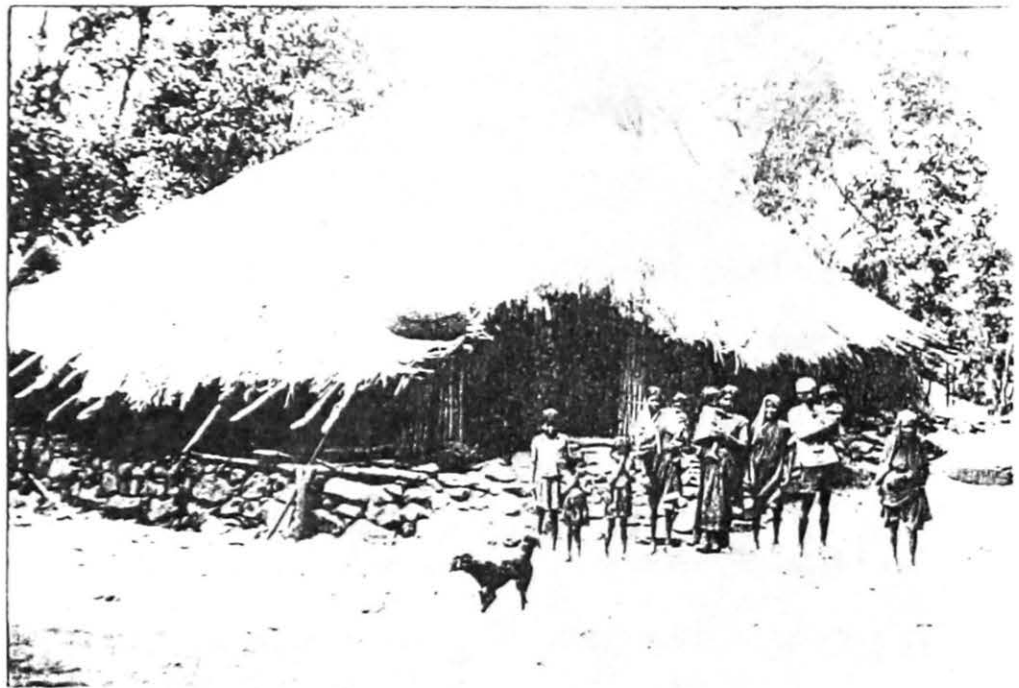
The programme also includes the scheme of installation of go-bar gas plants to save the time spent on brushwood collection. Three sites are selected in Shirkoli and work on one plant was begun in February 1986 but the work is yet to be

completed. Solar panels were installed in February 1985 and four tube lights and one T.V. set were fixed. The unit was however dismantled in May i.e. before the rainy season. These are highly capital intensive projects and do not show a promise of replicability. Attempts to install improved smokeless chula was also made, but did not meet with much success. The efficiency of the models is not so high as to effect a saving to the extent of about 50 per cent so that the people find a marked saving in the labour-time. This is because, many of the models are still at an experimental stage and some problems arise due to the specificities in local application (for example, size of pots used). Unless they are fully adopted to the local conditions and prove to be markedly more efficient they are not likely to be accepted. For lighting kerosene is used, the consumption of kerosene was about 20 to 25 lit. per annum per family.

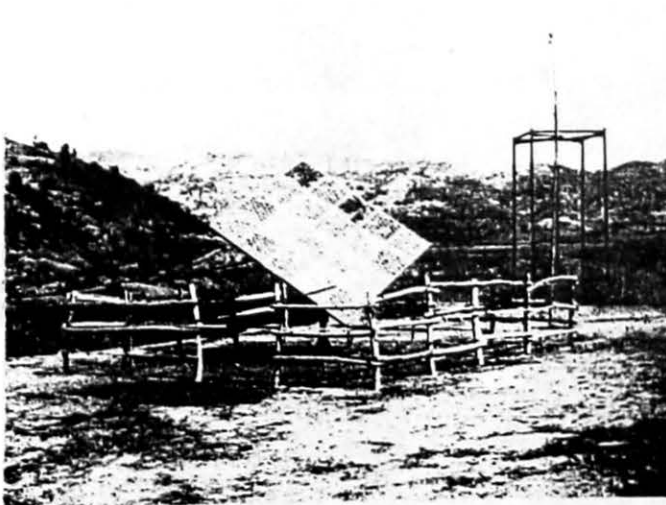
Durables: Brass utensils are used by most of the peasant families, poorer families had aluminium utensils. The families rarely possessed any items of furniture. Kambal, a rough blanket made of wool (made by khutekar Dhangars) is spread as a mat to squat on the floor, it is also used as a blanket and as a cover for protection from rain. Plastic sheeting is now coming into use as a rain cover. Use of bicycle is rare as the terrain is not suited for bicycle use. (Table 4.15) The usual means of movement is on foot. Transistor radio set was reported



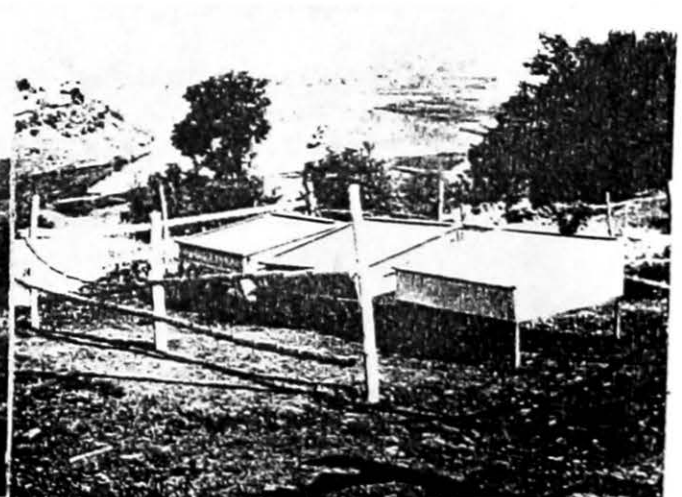
36. Village House with Tiled Roof



37. Village House with Thatched Roof



38. Solar Panels in Shirkoli



39. Solar Stills in Shirkoli

by a few families. Use of wristwatch was more frequent. In some of the smaller villages no family reported a wristwatch while at least a few families had a wristwatch in the bigger villages. The main manufactured items purchased by the villagers are soap, match box, kerosene, paper and stationery if there were school-going children and the clothing. Use of footwear - chappals has now become common.

15. Housing:

The houses are constructed mainly with the use of the local material. For structural frame timber poles are used, the walls are made of wattle plastered with mud+dung mixture or of local stone with mud. The roof is slopping and is usually covered with grass. Every year new layers of grass are added. The structure lasts for 25 to 30 years. The basic unit is khana which is about 1.5 metres in width, the length varies considerably. Majority of the peasant houses had 3 to 5 khan. The houses in zone IV are relatively larger; these families were not displaced due to the construction of the reservoir. (Table 4.16) Poorer families had one khan houses. These are usually like huts supported on four bamboo poles and roof members. Some of the large families had houses with 6 to 8 khan. The better income families had houses with tiled roofs.

The average length of a house was about 8 metres. The house is divided into three portions - the outer padvi - about

Table 4.14: Average Consumption of Food Per Day Per Adult in the Main Villages in the Panshet Catchment Area

Item	Daily consumption per adult (in grams)	Item	Daily consumption per adult (in grams)
Rice/vari	100	Vegetables	40
Nachani/jowar	600	Sugar/gur	22
Lentil	16	Oil	8
Pulses	24	Meat/fish etc.	10

Table 4.15: Proportion of Families* Reporting Ownership of Wristwatch, Radio, Bicycle and Sewing Machine

	Percentage of Families Reporting Ownership of			
	Wristwatch	Radio	Bicycle	Sewing Machine
Zone I	33	15	3	3
Zone II	25	8	1	1
Zone III	20	6	4	-
Zone IV	20	-	-	-

* Refers to families covered in the survey from the main villages, does not include Gavli Dhangar families

Table 4.16: Distribution of Families* by Size of House in the Panshet Catchment Area

	Size of House (in terms of no. of <u>khan</u>)						Total
	1	2	3	4	5	6 and more	
	Per cent families						
Zone I	3	6	50	8	17	16	100
Zone II	8	11	51	4	24	2	100
Zone III	6	10	48	1	24	11	100
Zone IV	-	7	20	13	51	9	100

* Refers to families covered in the survey from the main villages; does not include Gavli Dhangar families

2 metre long, a slightly elevated oti, 2 metre long and the main room about 4 metre long with cooking arrangements in one corner. (Fig. 4.7) For cattle padvi is used. The animals and the humans thus live under the same roof. An average-size house requires 100 to 150 poles and about 800 to 1000 pendis of grass for roofing. The houses are constructed by the owners with the help of a carpenter.

There are rarely any windows or openings in the wall. The houses are dark, ill-ventilated, and bugs and flea infested. The room is full of smoke when the chula is fired for cooking. As twigs, small branches are used as fuelwood and the chulas have very low efficiency the smoke menace is serious.

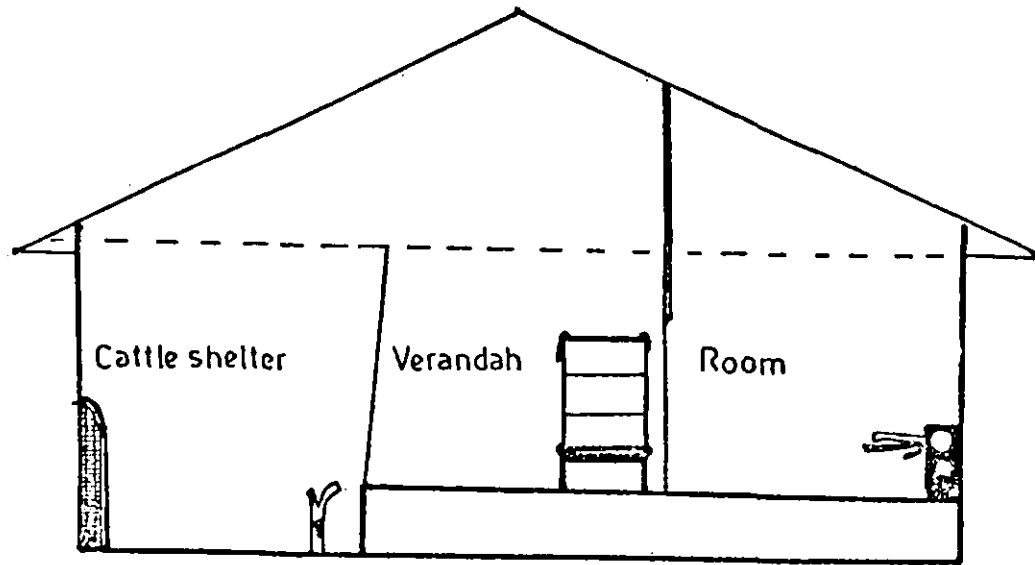
16. Utilization of the Biomass Resources of the Region:

As noted above the existing biomass resources are being used to meet the needs of fuelwood, for house construction, for charcoal making. Timber and bamboos are cut for sale. The estimated annual exploitation of trees for charcoal making, timber and other uses came to about 2500 tonnes and that of brushwood about 2400 tonnes.

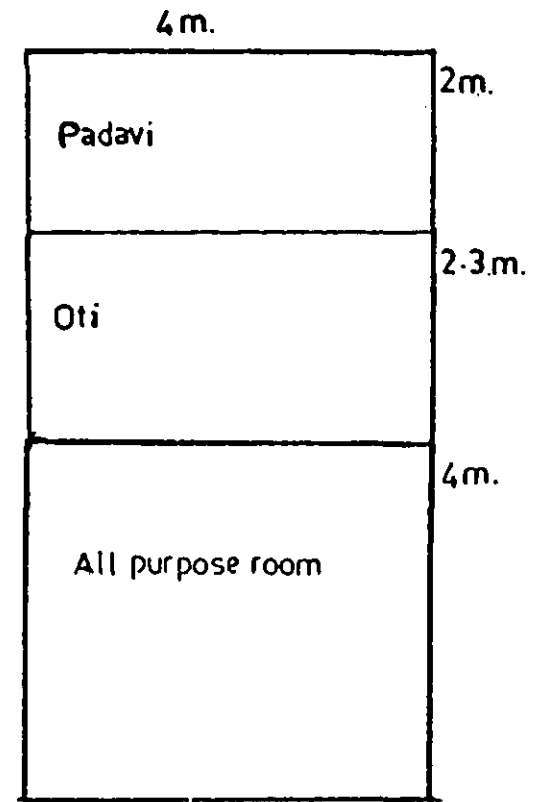
To estimate the existing stock of trees in the region the averages obtained for the shifting cultivation areas, forest areas and the sacred groves were applied zonewise and aggregated. Zones I and II are almost devoid of trees and the charcoal making activity is confined mainly to the villages from

Fig 4.7

VILLAGE HOUSE



Cross-section



PLAN

zones III and IV particularly to the larger villages like Shirkoli, Mangaon, Tekpole, Dapsare. Those villages still have some forest cover and sacred groves which are being gradually encroached upon. The regrowth is limited in these areas because of cattle and human interference. Regeneration of trees is virtually impossible over the remaining vast stretches which are already dominated by Lantana and Carvia callosa that threaten of remaining as a sub-climax. It is feared that the exploitation of trees at the present rate will mean almost the total destruction of the forest in this region within a 10 to 15 years period.

17. Economic Activity of Gavli Dhangars:

Livestock is the main source of livelihood for the Gavli Dhangars. They have been occupying the upper terraces with ample grazing lands and sparse population. Traditionally buffalo was the main milch cattle maintained by the Gavli Dhangars. (Gadgil, Malhotra, 1979) A herd of about 10 buffaloes or some equivalent mix of buffaloes and cattle was needed to meet the basic needs of the family. The milk could not be sold due to the lack of transport facilities and they sold mainly butter or ghee and in some parts khava.

The Gavli Dhangars got incorporated in the market nexus through the milk-collection organization. However, the important point to note is that the organisation of production

has remained unchanged. The family unit continues to be the basic production unit, and production and consumption of the basic means of subsistence are not divorced from each other. The major change is the near-total de-linking of milk production from family consumption. Even though milk is marketed, dairies have not developed as a business in this tract. The milch cattle is of local breed and is obtained from the home stock. It subsists mainly on grazing and very little effort is made to improve the cattle feed to increase the milk yield. It must be recognized that under the present conditions it is not possible for the Dhangars to view milk production as a business, since there are several factors that are beyond the control of the Dhangars. With so much of risk and uncertainty it is difficult to make calculated investments anticipating a rate of profit with some degree of certainty. For example, Gavli Dhangars face a serious shortage of drinking water for the cattle, particularly during the summer months. There is a lack of proper shelter for the cattle. The much-needed veterinary service is not available. The supply of fodder is also not adequate. Even the locally bred sturdy livestock succumbs due to a variety of adverse factors. They cannot possibly shift to improved breeds under such conditions.

Gavli Dhangars thus continue their traditional vocation but under changed circumstances. It is estimated that a herd of an optimum size of a single house hold (10 buffaloes or

equivalent mix) needs about $.5 \text{ km}^2$ grazing lands. However, the grazing lands have become restricted as the peasants were pushed from the valleys due to submergence of their lands and the increasing pressure of grazing has led to overgrazing and deterioration of the grazing lands reducing further their cattle carrying capacity. They are thus caught up in a vicious cycle of progressive deterioration of the pasture lands and are forced to restrict the number of cattle they can maintain. Buffalo requires relatively richer grazing grounds, more water and shade, whereas cows can better tolerate a scarcity of fodder and can reach terrain inaccessible to the heavier buffaloes; shift to cows is noted with increased pressure on pasture. (Gadgil, Malhotra, 1979) The average size of herd in the Panshet catchment was noted to be about 10 heads, $2/3$ buffaloes, $2/3$ cows, $1/2$ bullocks and the young ones.

The yield of milk per lactation was noted to be about 500 to 700 litres in the case of buffalo and only about 200-250 litres in the case of cow. Most of the Dhangar families interviewed complained that due to the deterioration of pasture resources they cannot maintain a herd of adequate size and consequently it is difficult for them to meet their bare subsistence needs.

Agriculture: Nearly all the Gavli Dhangar families have to supplement their earnings through cultivation of inferior

milletts like Eleusine coracana (nachni), Panicum milliaceum (vari), Panicum miliare (Sava), which are used for home consumption. Some of the families owned a piece of land, some have encroached on the Government waste lands, and some have taken land for cultivation on a share-crop basis. It is difficult to ascertain the size of cultivated holdings, because part of the land brought under cultivation through encroachment is not properly surveyed and measured. The land in this hilly tract is shallow and poor and it is essential to keep it fallow for 10 to 15 years after taking crops for three-four years. The rotation cycle is as follows: 1st year - nachani; 2nd year - vari; 3rd year - sava. The land under cultivation gets shifted from time to time. For ploughing, a wooden plough or hoe is used depending upon the nature of land. For traction bullock power is used. Nearly half of the cultivating families owned a pair of bullocks. The bullock-less families or those owning one bullock are not often able to plough their land properly and on time.

It was reported that the productivity of land has declined due to soil erosion and reduction in moisture levels, so that it was necessary to put a larger piece of land under cultivation to obtain a given quantum of foodgrains. Consequently extension of cultivation to steeper lands or lands totally unsuited to agriculture was noted. In the long run

this would lead to further soil erosion and degradation of lands. However, the Dhangars are today pushed to the cultivation of marginal lands mainly because of the progressive deterioration of the forest and pasture resources. The per family production of cereals broadly varied between 2 and 4 quintals per annum. Some families did not own any land and also did not have the means to bring waste land under cultivation. A few families did not even own any livestock and they had therefore to take to wage work.

Division of Labour: The traditional division of labour between sexes has remained more or less unchanged. Women are responsible for cleaning the cattle pen, collection of fodder to be stored up for the use in the rainy season and for fetching water. They, at times, deliver the milk at the collection centres. Men are responsible for milking the cattle and delivery of milk and may also help in bringing of fodder and fetching water. The only noteworthy difference is that the work of preparing butter/ghee which was the responsibility of women is no more there; fresh milk has instead to be delivered at the milk collection centres. This involves a daily trip covering on foot a distance of 2 to 5 kilometres and it is the man who usually takes up this task. At the same time it must be noted that the time required and the energy expended for tasks like collection of firewood or fetching of water, particularly in summer has increased because of deforestation and this has meant an increased burden of work on woman.

The work of clearing the plot and firing it is taken up by both men and women, while ploughing is exclusively the man's responsibility. In operations like sowing, and harvesting men and women usually work as a team. The Gavli Dhangar families also engage seasonally in the collection of some forest produce. Men, women and children join to collect apta leaves, or picking of fruits like karvand. Tasks like collection of honey or harvesting mango or jackfruit is usually undertaken by men and boys, and the produce is generally marketed by men.

Diet: The diet generally consists of a nachani bhakar and chilli-powder or onion to gulp it with. The Dhangars cannot afford to have vegetable side-dishes or curry in their daily diet. The estimated average daily consumption was 600 grams of cereals per person. In addition 20 grams of pulses, 20 grams of jaggery and 7 grams of oil were consumed per day per person. The daily sale of milk has adversely affected their diet. Nearly all the milk is now sold out and consumption of butter-milk which was quite substantial got almost reduced to zero. This amounts to, on an average, a reduction by 200 calories per day per person. The loss of butter-milk consumption is not made up by purchase of substitute nourishing food items. The marketing of milk has thus resulted in a definite deterioration of the diet of the Dhangars; a nourishing item has been subtracted from a diet which is not varied and balanced.

Despite the fact that the Gavli Dhangars have been inhabiting a tract rich in wild animals, including mouse deer, barking deer, sambar, wild pig, jungle fowl, pea fowl, black naped hare, they had not developed any tradition of hunting. However their traditional diet, which was mainly based on home-produced livestock products - chiefly butter-milk, some poultry, and honey, fruits, nuts and other forest products together with the millets they cultivated, it is computed, provided them with adequate protein and calorific intake. (Gadgil, Malhotra, 1979). Currently, however, the Dhangars are able to get only some seasonal fruit like mango, Vangueria spinosa (alu), Artocarpus integra (phanas), Syzygium cumini (jambhul) and in rainy season some vegetable like Cassia tora (takla) or some tubers and roots from the forested areas. The supply of these fruit and vegetables is also adversely affected with the deterioration of the forest wealth.

With the daily sale of fresh milk the calves are not being allowed to suckle as before, thereby stunting their growth, delaying the age of reproduction and worsening the fodder-to-milk conversion ratio.

Housing: Houses of Gavli Dhangars in most of the clusters are poor and constructed using the local material. A wooden frame of country timber makes the structural frame, for roofing grass or leaves are used and the walls are made of wattle or



40. Cooking in Dhangar House



41. Dhangar Woman and Child



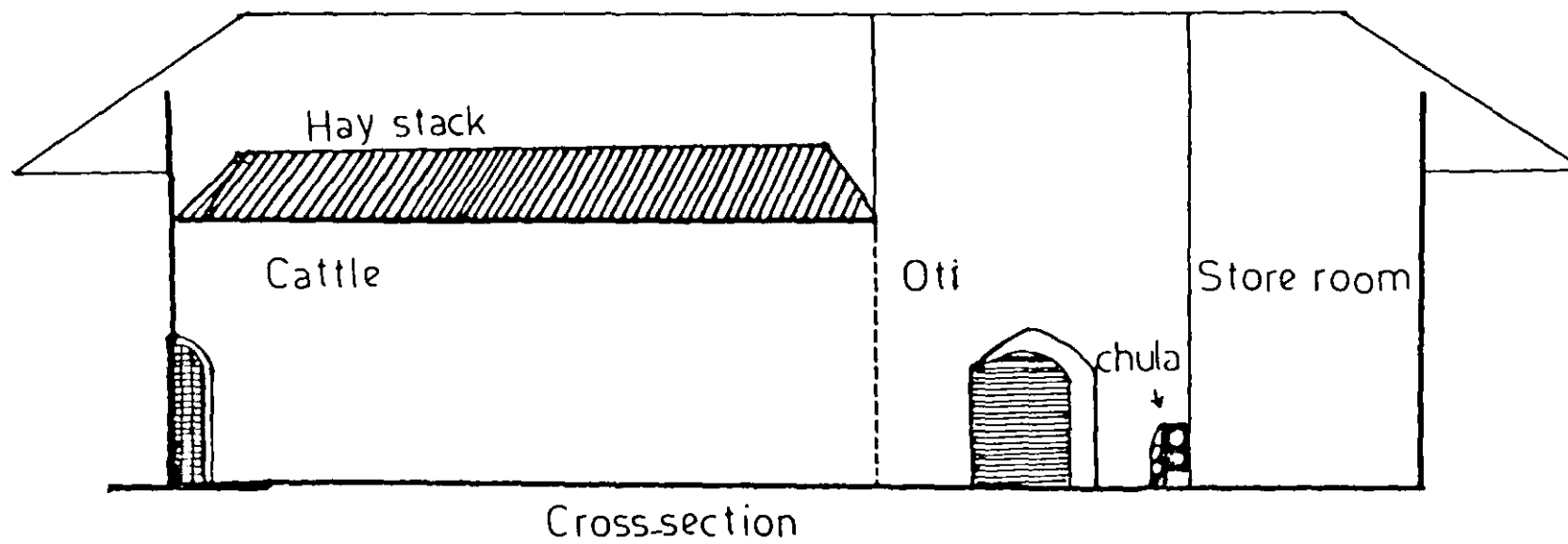
42. House in Dhangarwadi

bamboo and plastered by mud-cow-dung mixture. The floor is also plastered by cow-dung. The humans and the animals still live under the same roof. The house consists of a long room - the front portion (60 per cent of the area) is for the animals where the roofing is low; the back portion which has a little higher roof is used by the humans. This part is usually divided into two portions - the outer part used by the menfolk and the inner portion by women, for cooking, etc. (Fig. 4.8) The houses are thus unhygienic, full of foul smell and flies. The roof leaks in the rainy season, thus increasing the incidence of cattle mortality.

In the sphere of domestic life, very few of the factory products have reached the Dhangar habitat. They use firewood as fuel, oil-lamp or lantern for lighting (possession of a torch was not reported). Primitive stone grinder is used to grind the flour and a stone slab to grind chillis. Facility for drinking water is almost totally lacking. They have to walk down the hill and bring tinfu] of water at a time, to meet the needs of water for drinking, cooking and other purposes. Brass utensils have partly replaced the earthen pots, but for water storage or for storage of food-grains earthen vessels are used. Use of washing soap was reported by a few families.

Fig 4.8

HOUSE IN DHANGAR WADI



-140-

18. Major Problems:

Speaking about the main problems faced by the Gavli Dhangars, repeated mention was made of the inadequacy of land for cultivation so that they are not able to grow enough foodgrains needed for the subsistence of the family. Other problems mentioned were: (i) Lack of capital needed for running the livestock business and particularly for the purchase of milch animals; (ii) Lack of funds to construct a proper shelter for the cattle that can withstand the heavy monsoon rains (due to the leakage and the consequent exposure the incidence of cattle mortality increases); (iii) The lack of fodder in the summer months leads to consumption of fruit of Ficus glomerata that does not agree with the cattle (this increases the risk of cattle mortality); (iv) Shortage of water particularly during the summer months results in digestive disorders (the task of collecting and carrying water for household consumption and for the cattle involves expenditure of enormous amounts of time and energy); (v) Lack of alternative avenues of work/employment to supplement their meagre earnings; (vi) Dependency on Marwari (private moneylender-cum-trader) from whom loan has to be obtained to meet the deficit in the current expenditure; (vii) Irregularity in receipt of cash for the milk delivered to the cooperatives (as per regulations the payment is to be made every fortnight; sometimes the payment is, however, reportedly delayed even for over a month).

19. Pattern of Illness and Medical Care:

The pattern of illness amongst the people in the project area is a mixture of a typical picture of a deprived and underdeveloped community and a few specific features. The determinants of the health of the people - nutrition, sanitation, housing, working conditions, health-education, availability of modern medical care - all are in a poor state in the Panshet catchment area.

Nutrition: The usual diet consists of rice or bhagar and kalwan, Bhakaris made up of nachani and chatni; occasionally fish or meat is used in place of chatani, or dal. Day by day larger and larger part of whatever milk that is available is sent out for sale. Same is the case with eggs. The diet is quite deficient in proteins, vitamins and oils. Hence there is widespread malnourishment which also predisposes the people to a variety of ailments.

Sanitation and Housing: One peculiar feature of the area is the tradition of keeping the cattle in the same house, in the same room in which the family lives. The cattle is generally kept at a lower level and the "living room" is a couple of steps higher but there is no wall in between and the litter and the resultant flies and insects thrive in the house.

A second feature of this area is extreme paucity of water from January to June. Women have to go down for two

kilometres or so to draw water (often muddy) from streams down the hills. This shortage results in increased insanitation and hence increased incidence of diarrhoeas and skin-infections during this period.

Working Conditions: They are more arduous than in the plains, torrential rainfall, biting cold-winds, difficult, sloppy terrain, primitive tools and implements - all together make labour very arduous.

Health-education and Availability of Modern Medical Care: Until recently, this was hardly existent. Traditional health-care, is unable to prevent the development of serious disorders and complications. This is shown by the fact that, whenever possible the people bring the ill from a distance of 20-30 kilometres to Panshet township for medical treatment, even if there is no bus service (except to certain places during January to May) or even if bullock-carts can't be used due to difficult terrain. From 1978 a Zilla Parishad launch equipped with dispensary visits certain villages by turn. But it is closed during heavy rains and in general meets only a part of the requirements of this area. Malaria workers conduct spraying and Chloroquin tablets have been kept in certain villages. But until recently, none of these ever reached the Dhangarwadis.

Pattern of Illness: As a result of these poor conditions, following illnesses constitute the majority of illnesses -

1) Undernourishment has a specially deleterious effect on the children and pregnant women. Young children are particularly susceptible between the age of one and two years when breast feeding does not provide adequate nourishment and they are not fully adjusted to the adult diet. Due to malnourishment the children succumb to night blindness. Specific manifestations like anaemia, vitamin A deficiency, stunted growth in children are common. Feeling of tiredness, bodyaches etc., among the adults are the results of undernourishment and overwork.

2) Diarrhoeas are common especially during the summer and rainy season.

3) Colds, coughs, fevers are very commonly found in the rainy season as a result of rough weather, poor shelter, poor nutrition. Malaria is found throughout the year and along with other fevers, is much more predominant than in the plains.

4) Skin infections and eye infections are common in summer.

5) Incidence of worms, chronic ear discharge in children is high, as is the case elsewhere. But dental caries appears to be less.

Increased Health-education and Medical Services in Recent Years:

From 1981, Garib Dongari Sanghatana, organization consisting predominantly of the Dhangars in the area has been formed.

This organization, sponsored by the Village Community

Development Association, a non-Government body, has taken up

health-conscientization work from 1981. Activists of this Sanghatana have been trained at Panshet township by a doctor from Pune. These activists treat ordinary cases of diarrhoeas, fevers, worms, malaria, superficial skin and eye infections, distribute iron pills to pregnant women and vitamin A to children. Chloroquin tables and iron and vitamin A have been supplied by the Govt. and the rest of the medicines are made available at a uniform rate of 10 paise per tablet. Health conscientization is the chief aim of this work and through this modern health-education, preliminary medical care is made available at a cheap rate in the remotest of the hamlets for the first time. This activity is carried out predominantly in the Dhangarwadis.

From 1983, the Govt. has lowered the educational criteria for the selection of Village Health Workers in its own programme in this area and it is through these health-workers that now, a few simple medicines are made available free of charge in many villages. The medicines are however, generally in short supply and the workers are poorly trained. Increased pressure is being brought on the villagers to undergo sterilization operations. But there is a lot of resistance to this.

Availability of medical care for ordinary illnesses has definitely helped the people, has reduced their sufferings and medical expenses. The overall health-picture cannot however be improved unless the overall socio-economic conditions are improved.

CHAPTER V

Redevelopment Programme for Kuravati Shirkoli and Mangaon

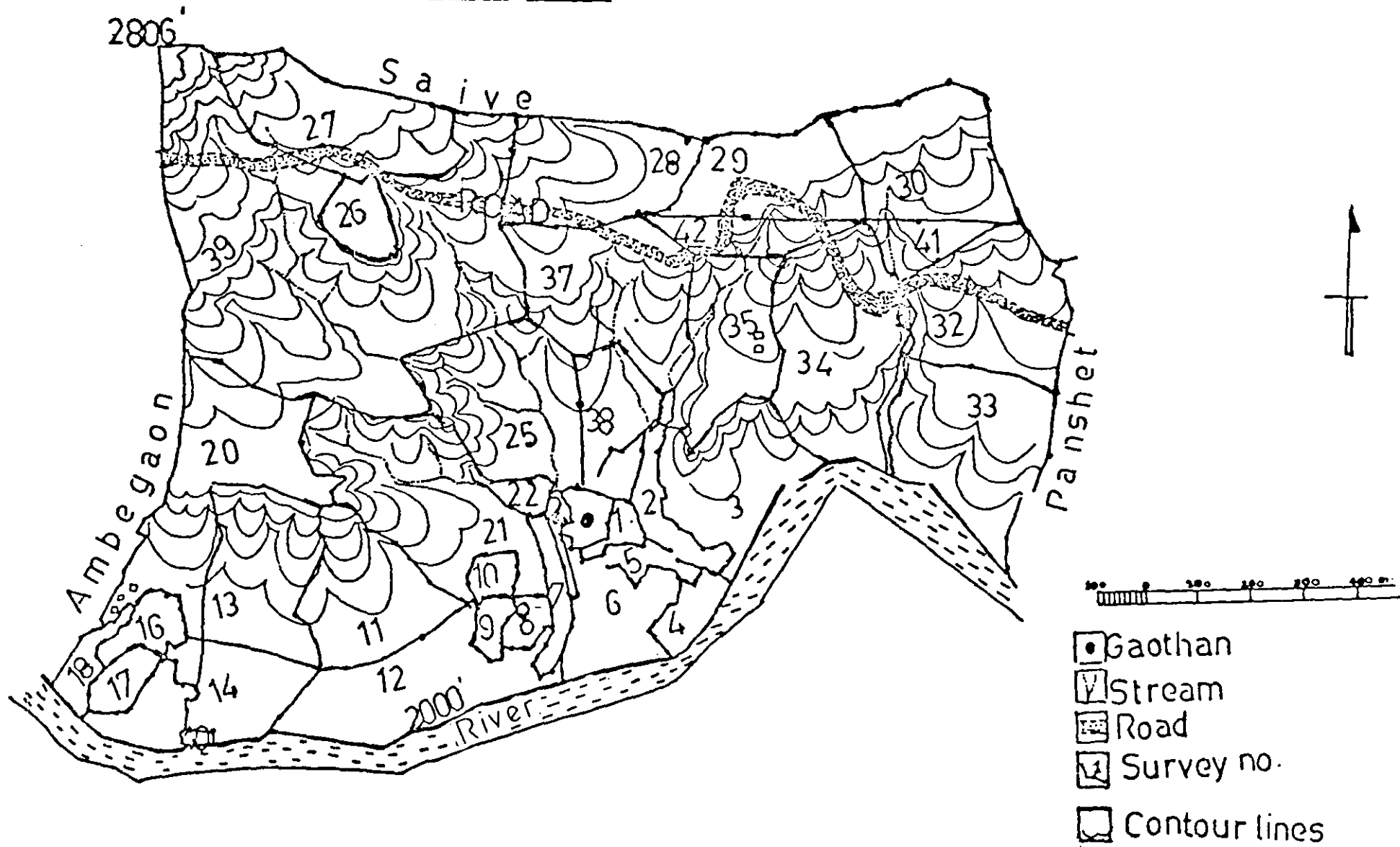
Section I: Kuravati - A Depredated Village

Kuravati is a small village (12 families) located on the northern side of the Tanaji Sagar at a distance of about 2 km. from Panshet township. The terrain in general is rough, very much broken. The valley region is separated by steep barren hills. The highest peak in Kuravati is located towards the south-west side at an altitude of 855 metres. Table lands are rare; more than 60 per cent of the area has higher than 20° slope. Soil cover is shallow, the average soil depth is only about 8 cm.s. The chemical characteristics of the soils in Kuravati are as follows: pH is neutral except in cultivated fields and on the upper slopes, where soils are slightly acidic. Average pH is 6.65 while the lowest pH recorded is 5.8. Soluble salts are at safe level. The average organic carbon content is .435 kg/ha, Potash - 249.7 kg/ha and Phosphorus - 15.7 kg/ha. The average annual rainfall at Kuravati is about 2000 mm.s. There are three streamlets in Kuravati two on the eastern side and the third on the western side. All the three streamlets dry up in the summer.

Vegetation: To study the vegetation of Kuravati and the intensity of biotic interference thirty quadrats of 10m x 10m size were taken from the lands belonging to the forest department, 15 from the patch located above the road and 15 from the patch located below the Panshet - Gondekhal road. The patch above the road

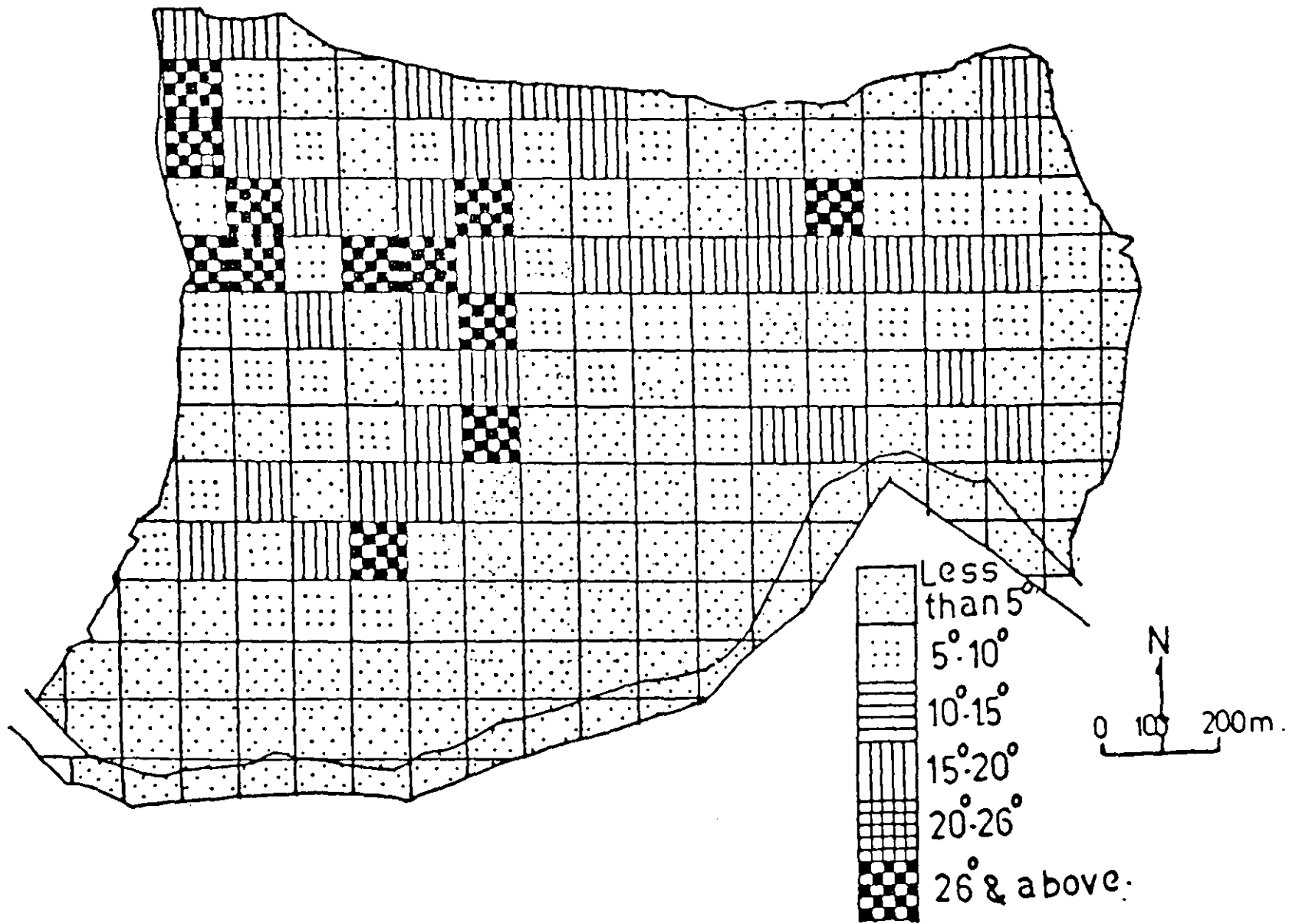
Map-9

Contour map of Kuravati village (Before the construction of the dam)



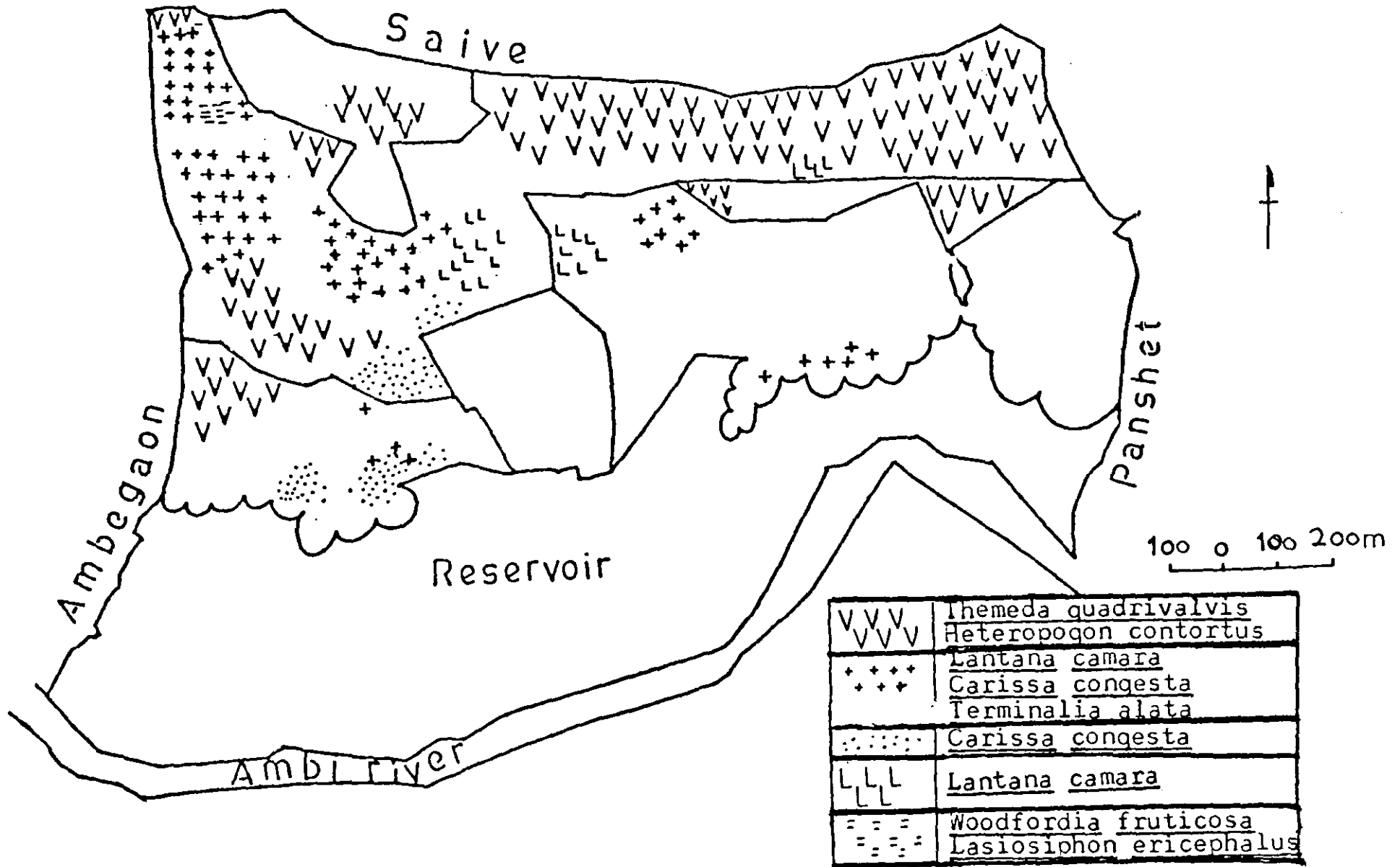
Map-10

SLOPE MAP OF KURAVATI (Before the construction of the dam)



Map.11

Vegetation map of Kuravati



close to the top of the hills, is moderately disturbed while the latter patch of forest is located near the village and has suffered heavily due to grazing and hacking.

In the patch above the road Lantana camara, Woodfordia fruticosa and Carissa congesta are the dominant shrub community, exhibiting a frequency of more than 80 per cent while Lasiosiphon eriocephalus, Meynea laxiflora and Pavetta bengalensis are the common shrubs showing a frequency between 40-46 per cent. The only tree species which is dominant is Terminalia alata; it shows a frequency of 80 per cent. The next tree in the frequency order is Bauhinia racemosa, with a frequency of 40 per cent. The composition of the plant community in the forest patch below the road is more or less the same as noted above. However the number of plant species per quadrat is considerably less. There are almost no trees; most of them have been either cut down or lopped. Lantana camara and Carissa congesta are the dominant shrubs showing a frequency of more than 90 per cent. The next common shrub which occurs is Lasiosiphon eriocephalus with a frequency of 40 per cent. Terminalia alata is the only dominant tree with a frequency of 66 per cent. The quadrat study was first carried out in 1983 and was repeated in 1986. It was noted in 1986 that the vegetation is dominated by the same plant community as noted in 1983. The current survey however indicates an increase in the number of plant species per unit area in the

patch above the road and also the occurrence of Allophyllus serratus, Jasminum malabaricum, Pavetta bengalensis and Embelia tsjeriam-cottam. This indicates the secondary successional stage; if protected, climax stage should be a deciduous forest.

Economic Activity: Kuravati lost nearly all the cultivable lands due to submergence. Only about 3 hectares of land is under shifting cultivation and there is no rice land. A total of 129 hectares of land out of 193 geographical area was acquired. Of this a small piece of land (about 8 hectares) that is not submerged is still owned by the irrigation department. About 50 hectares belong to the forest department. The private land thus extends over some 14 hectares only. Eventhough there are only 12 families in the village the land base is too slender to sustain these families. The main source of income is therefore wage employment at Panshet township where five workers work year round and 10 go for seasonal work.

The reported number of bovine population in 1984, was 20 bullocks, 14 cows and 6 buffaloes. Since the private lands are meagre the cattle freely move into the lands belonging to the irrigation department and forest department. There is in addition an influx of some 40 cattle heads and over 50 goats belonging to the Dhangars from the neighbouring village of Saive.

It was noted that as the total land available for cultivation is very limited the fallow period is reduced to four years. Such a reduction in the fallow period coupled with the conditions which are highly conducive to mycotoxin producing fungal attack, i.e. rains drenching the crop before harvesting, affected the nachani crop during 1985. The two fungal species isolated from the infested plants are Claviceps purpurea from the infested spikes and Helminthosporium nodulosum from the stalks and leaves.*

The villagers suffer due to the shortage of grazing lands, which are now much degraded where only kusali and bonqrut occur. The villagers also face a shortage of fuelwood. As the vegetation cover is sparse they have to go hunting for karvi and rametha brushwood and spend 5/6 hours daily to collect the necessary quantity.

There is thus an acute shortage of land for cultivation, the yields are low and the crop infested, the grazing lands are inferior and inadequate even when the villagers encroach upon the lands belonging to the forest department, tree cover is lacking, the consequent soil erosion is degrading the lands further.

* The alkaloids produced by the fungus claviceps that causes ergotism in animals can lead to convulsive violent muscle spasms alternate with quite periods and sharp retractions of the heads, increased salivation, abortion, decreased milk production. The consumption of 100 grams of ergot over about 100 days is noted to show among humans symptoms of convulsive or nervous forms that include tingling, itching, numbness of hands and feet, twitching, muscular cramps and sustained spasms and convulsions. On enquiry, such symptoms were not reported in Kuravati.

Only a limited wage employment is available at Panshet township. The villagers thus face the problems of underemployment, low incomes with little prospects for improvement. Unless a radically new approach to the redevelopment of the region is accepted, the future of the inhabitants of Kuravati and other villages like Panshet, Ambegaon, Dhindli from the Ist zone is bleak. An attempt is made in the following to work out an alternative plan of development taking into account the limited resource base of the village, the needs of the villagers and the need to restore ecological balance.

Redevelopment Programme: The entire land in the village can be grouped under (a) protected lands, (b) production lands, (c) reservoir bank, (d) stream bank, (e) back-yard gardens and (f) road side for drawing out the plan of redevelopment of vegetation.

(a) Protected Lands: The total land of about 50 hectares belonging to the forest department needs to be reserved for putting under permanent vegetal cover as these are located on the upper hill slopes with a steep gradient. It is essential to keep this tract undisturbed; it needs a full protection from grazing and other interference. In Kuravati most of the eastern hill slopes belong to the forest department and the patch situated below the road is in a degraded condition. Natural regeneration in these areas will take a long time. Thus certain suitable plant species

like Terminalia alata, Bridelia squamosa, Butea monosperma in two rows are suggested along the contour lines on the western side slopes and a close plantation of Gmelina arborea and Dalbergia latifolia, on the eastern hill slopes at 2m x 2m spacing with a lower shrub cover.

(b) Production Lands: These lands include 12 hectares of private land, where presently various agricultural crops like nachani, vari and karale are cultivated, but in any one year about 3 hectares are under crop. A piece of land admeasuring 8.36 hectares acquired by the irrigation department can be utilized for the fuel and fodder crops as the present private farms cannot fulfill these requirements.

Prior to the construction of Panshet reservoir the land surface was covered with a great variety of grasses, a few legumes and other native plants. Now the dominant grasses in the farm lands are Heteropogon contortus and Themeda quadrivalvis; but their feeding value is less, hence these are considered as of medium economic value. The high quality grass is characterised by leafiness, bright green colour, a pleasant aroma, pliable texture, palatability and high nutritive value. The nutritious species like Dichanthium, Chrysopogon montanus, Iseilema laxum, and Arundinella rarely occur due to biotic and other influences. Consequently, the availability of fodder is less than what is needed. Best results can be obtained through better range-management methods. The main directions in this

regard are selection and cultivation of nutritive grasses. The total 12 hectares of private land holdings which are located on the middle slopes can be used for this purpose. For best results the grass lands must be grazed or harvested before the seeding stage. At this stage the grass is more nutritious and palatable and it has a more stimulating effect on milk production. In addition quick maturing trees of economic value but which are not browsed by the cattle e.g. Gmelina arborea, Melia composita can be grown with a spacing of 10m x 10m.

The upper slopes which belong to the forest department need to be protected from grazing. The grasses that grow in these areas can be harvested by the farmers for use in the summer season. The maintenance of forest land would need full cooperation of the villagers; this could be ensured if the necessary fodder supply is provided. For this it would be necessary to go in for a combination of grass with tree-leaf fodder, say in the ratio of 6:4. The grass lands can be rotationally grazed in the following way. The grazing grounds should be divided into five blocks of equal size. Each of the block can be demarcated by natural objects, such as trees or large boulders. One block should be completely closed for grazing, two of the blocks should be allowed to be grazed moderately and the two remaining blocks should be rotationally grazed. This will make for more efficient utilization of the herbage as it confines the grazing animals so that they obtain

their fill without trampling the entire grazing grounds. If ungrazed herbage, and weeds are weeded out and dung is collected from the grazing lands, healthy growth of grasses can be achieved. With proper management it is possible to procure 7 to 8 tonnes of grass per hectares. The shortage can be met through the use of tree-leaf fodder, the tree-leaf fodder can be obtained by growing trees like Leucenia leucocephala, Butea monosperma and Ficus species in 5 hectares belonging to the irrigation department, and the remaining 3 hectares of the same plot can be utilized for fuelwood plantation of Leucaena leucocephala and Dalbergia sissoo.

Since it is suggested that shifting cultivation should be discontinued and that these lands should be put under grasses and trees, the livestock composition will have to be appropriately changed. If there is no cultivation, bullocks will not be needed; cows are mainly maintained today with the view of obtaining bullocks from the home-stock. The livestock rearing need not any more be bullock-oriented, but should be milch-cattle-oriented viz., buffalo, and improved cows. The number of milch cattle will have to be adjusted according to the availability of fodder. It is also essential to provide the necessary veterinary service at Panshet township.

(c) Reservoir Bank: Banks above the highest water-level along the reservoir require a permanent and continuous green belt of two to three hundred metres width to capture the eroded soil at the

last front and to prevent the silting of the reservoir.

Profiles of such a green belt may be differentiated into three sub-zones.

- (1) the first sub-zone will be exposed to partial submergence during the rainy season.
- (2) the second sub-zone will not be exposed to submergence but will have a good moisture content in the soil.
- (3) the third sub-zone will not be exposed to submergence, but will serve the purpose of providing shade to the middle zone.

The first sub-zone of vegetal cover along the reservoir bank should be of five metres width, the plant species that can grow even in a partial submergence area are Vitex negundo, Homonia riparia, and Salix sp. The second sub-zone along the reservoir with a width of 150 metres should be under mulberry plantation for sericulture. Sericulture is a cottage industry with an agricultural base; it does not involve long training and is essentially labour intensive. Out of the four commercial varieties of *Morus alba*, the variety M₅ is best suited for reservoir bank; it can tolerate the long dry season. If irrigation is provided the yields are twice as much. Fresh 15 cm. cuttings of mulberry can be planted along the furrows with a gap of 3 m. during June or July. The best season however, is during the pre-monsoon showers. Hundred metres of reservoir bank would require 1650 cuttings for strip plantation the strip being of 150 metre width. The plants easily establish in the rainy

season. If harvested from the 2nd year one acre of plantation sustains about 125 kg. cocoon production in one year. The expected yield under dry and irrigated conditions is presented in Table 5.1.

Table 5.1: Expected Leaf-yield of Morus alba and Production of Cocoons (one acre) .

Month	Leave yield (kg)		Production of cocoons (kg)	
	Dry lands	Irrigated lands	Dry lands	Irrigated lands
August-September	2000	2400	63	90
October-November	1300	2400	37	90
December-January	700	2000	25	75
February-March	-	1000	-	45
Total	4000	7800	125	300

Cocoons are purchased by Khadi Gramodyog on the basis of grading; the rate generally ranges between Rs.25-45 per kg. The cocoons are ready in about one month; under dry cultivation and with rotational harvesting of leaves it is possible to have 4-5 crops in a year. If a centre is opened up at Panshet township with the necessary facilities for cocoon rearing, the plantation of mulberry along the reservoir bank in the nearby villages can support this centre. The villagers can take care of the plantation and supply the leaves to the centre. It is

estimated that one person, engaged for full day in plucking mulberry leaves can earn about Rs. 8 to Rs. 10. The cocoon rearing centre can also provide some employment to the local people.

The third sub-zone will be a strip of hundred metre width to be planted with bamboo. Before taking up bamboo plantation it is necessary to establish some tree cover by planting trees like Terminalia alata. The selected bamboo species is either the native variety, that is Dendrocalamus strictus or Oxytenanthera monostigma, the commonly occurring bamboo in the Kolhapur region. These species can be propagated by three different ways. (a) The first method is by seed. Germination rate ranges between 60-80 per cent. Seeds should be freshly collected for better germination. The seedlings in the market are sold at a price of two rupees per plant while the raising cost will not cross 30 paise per seedling. (b) The second method that is widely practiced is by rhizomes. Healthy rhizomes are carefully separated from the mother plant and transplanted into pits. (c) The third method, which is practiced only in the Kolhapur region for Oxytenanthera sp. is through stakes. Stakes of 2 metre size are separated from one year old bamboo and then the stakes are transplanted into pits. Generally the survival rate is less in this method of propagation.

Bamboo plantation needs a 6m x 6m spacing; this amounts to about 280 plants per hectare. The clump gets ready for harvesting in 7-8 years. Subsequently bamboos can be cut in a rotation of three-four years. Though the initial yield of bamboos per plant is four, in the later years it will rise to 6 to 8 sticks per clump. Thus individual bamboo clump can produce bamboos in seven to eight year cycles. The wholesale price of a bamboo stick is four rupees while in market it fetches 8-10 rupees depending upon the length, girth and other qualities. (d) Stream Banks: There are three streams in Kuravati with a total length of about 2000 metres. Trees like Mangifera indica, Pongamia pinnata, Dalbergia sissoo and Melia composita in two rows should be planted on either side of the stream with a five metre wide cover of shrubs and small trees- Bauhinia recemosa and Cassia fistula with a spacing of 6 metres. (e) Back-yard Garden: For the yard adjoining the house various trees like Mangifera indica, Semicarpus anacardium, Artocarpus heterophyllus, Buchania lanzan, Dendrocalamus strictus, Garcinia indica and Dalbergia sissoo are suggested as these trees need some care and protection. Many of these plants fruit in summer, when the farmer is generally unemployed, and can take up the fruit harvesting work. In addition climbers of pumpkin, white gourd, cucumber, dodaka can be grown on the roof and along the fence and these vegetables can be marketed at Pune. (f) Road Side: A narrow dusty road starts from the Tanaji Sagar dam, meets another road from Warasgaon side in Kuravati village, which after one and half kilometers reaches

Ambegaon. There is no vegetation by the road side, but only half-exposed boulders. On the way to Ambegaon to the left above the village settlement four big gullies appear consecutively with a short gap inbetween. The kaccha roads are temporarily repaired every year by making cuts into the nearby hills. The boulders are turned to gravel and spread on the surface of the road. The torrential rains during the monsoon wash away parts of the gravel with a large quantity of soil, making huge cuts wherever the soil is loose. These road cuts slowly turn into big gullies with cattle and human movements. The roadside gullies in Kuravati have a width ranging between 2.5 and 3.5 metres and the depth is ranging between 1.5 and 2 metres. Soil conservation works can be carried out by elevating the road towards the reservoir side and making a channel on the right hand side to carry the rain water and by constructing bunds near gullies and diverting the rain water through proper channels. This can be followed by planting Gravelia robusta and Casuarina equisetifolia on the right bank in one row and Glyricedia maculata and Erythrina variegata and Dalbercia sisoo on the left bank in two rows. In addition there should be a shrub cover of Carissa congesta, Meynea laxiflora and small trees like Bauhinia racemosa and Cassia fistula.

Gully Control: Encouraging vegetation growth along gully sides and beds, is the best and safest way of stabilizing them.

Plants like Vitex, Calatropis, Agave, Embllica officinalis and Flacourtia latifolia are best suited for this purpose. Measures

like (a) diverting the flow from the gully, (b) reducing the inflow by treating the area with soil conservation measures, (c) fixing up temporary or permanent structures in the gully to regulate the water flow and to allow silt deposits for encouraging vegetation growth and (d) preventing cattle to enter the gully area should be taken up.

Planting: The planting should be undertaken at the break of rains. If it is direct sowing, seeds require warmth hence it can be done one week or so before the rains. It should be undertaken at a regular spacing. The spacing adopted varies from species to species. Generally closer spacing - 2m x 2m spacing, has been suggested for contour plantation and in other degraded forest land. As the survival rate of various plants in natural conditions will finally come at the most to 50-60 per cent, there will not be any crowding. Because of close planting it is expected that large gaps will not remain in the plantation. Certain precautions have to be taken as the germination capacity of seeds varies from plant to plant due to a variety of factors. For plants like Dalbergia latifolia the fertility of the seed is very poor, being about 1-2 per cent, although the tree seeds abundantly. In the case of seeds with a hard wall like Tectona grandis, Melia composita it is necessary to sufficiently moisten and crack the endocarp. In the case of trees like Dalbergia sisoo, Dalbergia latifolia, Bombax ceiba, Azadirachta indica and Butea monosperma root

suckers are produced freely, which originate from adventitious buds on the roots, particularly when the roots are wounded or when trees are felled. Afforestation requires different methods of propagation. Trees like Erythrina variegata, Salix sp. and Morus alba can be easily propagated by cuttings. Sowing can be made either by direct broadcasting along the contours or nibbling the soil and placing the seeds of various shrubs like Meynea laxiflora, Carissa congesta and Cassia fistula or planting them in furrows in the case of Morus alba, Salix, Leucenia leucocephalus etc., and in pits in the case of bamboo, Melia composita, Mangifera indica, Terminalia alata and Bridelia squamosa depending upon the capability and adaptability of individual plant species. Table 5.2 gives information about the plants suitable to zone I, the appropriate method of propagation, spacing, pretreatment of seed etc.

Section II: Shirkoli - From Tradition to Modernity : Shirkoli is situated on the southern side of the Tanaji Sagar, and falls in the second zone. It occupies an area of 1369 hectares out of which 59 hectares were acquired by the irrigation department. The village settlements are scattered in four colonies along the reservoir bank. Dhangars stay on the upper slopes far away from the village settlements. The highest peak is located on the south-west side of the village at a height of 1000 metres above the sea level. The upper slopes are very steep, while the lower slopes are gentle and have got better soil depths

Tab.5-2 PLANT SPECIES SUITABLE TO KURAVATI AND APPROPRIATE METHODS OF PROPAGATION

Plant name	Pr	So	SP	AP	Pr.	Sw/Kg	Ge (in /)	Pt
The first sub zone along the reservoir bank								
<u>Homonoia riparia</u>	S	F	1 _m x 1 _m	—	—	—	—	—
<u>Salix babylonica</u>	C,Su	F	"	—	—	—	—	—
<u>Salix tetrasperma</u>	C,Su	F	"	—	—	—	—	—
<u>Vitex negundo</u>	C	F	"	—	—	—	—	—
The second sub zone along the reservoir bank								
<u>Morus alba.</u>	C	F	3 _m x 3 _m	1600 _m x 150 _m	26500		90	N
The third sub zone along the reservoir bank								
<u>Dendrocalamus strictus</u>	S,R	P	6 _m x 6 _m	1600 _m x 100 _m		55000	80-90	N
<u>Oxytenanthera monostigma</u>	S,R,SI	P	"	"		"	"	N
<u>Phoenix sylvestris</u>	S	P	"	"	—	—	—	Cw.48h
<u>Terminalia alata</u>	S	P	"	"	—	—	—	Cw.48h

Plant name	Pr	So	Sp	AP	Pr	Sw /Kg	Ge (in/)	Pt
Road side				1500m				
<u>Casuarina equisetifolia</u>	S,C	P	3 m x 3 m			7 50 000	40-60	N
<u>Glyricidia sepium</u>	C	P	" m					N
<u>Gravelia robusta</u>	S	P	"			105 000	variable	N
<u>Erythrina variegata</u>	S,Sl	P	.			2000	50-60	N
Along the contour lines								
<u>Azadirachta indica</u> (l)	S	P	2m x 2m			4,400	70-75	N
<u>Bauhinia racemosa</u> (u)	S	P	"				80	N
<u>Eridelia squamosa</u> (l)	S	P	.					N
<u>Butea monosperma</u> (u)	S,Su.	P	.			1800	90	N
<u>Cassia fistula</u> (l,u)	S	P	.			5500	65	Bw 5m.
<u>Dalbergia latifolia</u> (l)	S,Su	P	.			24000	50-60	N
<u>Dalbergia sissco</u> (l)	S	P	.			14000	80	N
<u>Erythrina variegata</u> (u)	Sl	P	"			2000	50-60	N
<u>Terminalia alata</u> (l)	S	P	.			400fruits	40-50	Cw 48 h.

l : lower contour (750 plants required)
u : upper contour (1000 plants required)

Plant name	Pr	So	Sp	Ap	Pr	Sw/Kg	Ge (in%)	Pt
<u>Carissa congesta</u> (U,l)	S	F	1m x 1m	*	*	-	-	N
<u>Zizyphus rugosa</u>	S	F	"	*	*	-	-	N
For fuel and fodder								
<u>Dalbergia sissoo</u>	S	P	1m x 1m	7.39ha.		14,000 pods	80	N
<u>Leucaena leucocephala</u>	S	F	.	"			90	N
For private farms								
<u>Gmelina arborea</u>	S	P	10m x 10m	12.09ha.	} 3300	1000 kernels	80-90	N
<u>Nelia composita</u>	S	P	"			1700		BeßS.24h
Grass land								
<u>Arundinella Sp</u>	S	F		12.09 ha.	-	-	-	-
<u>Chrysopogon montanus</u>	S	F		"	-	-	-	-
<u>Dichanthium annulatum</u>	S	F		.	-	-	-	-
<u>Iselima laxum</u>	S	F		"	-	-	-	-

Plant name	Pr	So	SP	AP	Pr	Sw/Kg	Ge (in/)	Pt
Along streams				1000 _m +1000 _m	330+330			
<u>Bombax ceiba</u>	S	P	6m x 6m			28000	50-70	N
<u>Dalbergia sissoo</u>	S	P	"			14 000	80	N
<u>Gmelina arborea</u>	S	P	"			1000 kernels	80-90	N
<u>Mangifera indica</u>	S	P	"			8-10	90	N
<u>Melia composita</u>	S	P	"			1700		Beß 5.24.h
<u>Pongamia pinnata</u>	S	P	.			1500	75	Cw. 48 h.
House gardens								
<u>Anacardium occidentale</u>	S	P	+	+	+	500	90-95	N
<u>Artocarpus heterophyllus</u>	S	P	+	+	+			
<u>Buchanania lanzan</u>	S	P	+	+	+			
<u>Dalbergia sissoo</u>	S	P	+	+	+	14000 pods	80	N
<u>Dendrocalamus strictus</u>	S,R	P	+	+	+	55000	60-80	N
<u>Garcinia indica</u>	S	P	+	+	+			
<u>Mangifera indica</u>	S	P	+	+	+	8 10	90	N

Plant name	Pr	So	Sp	Ap	Pr	Sw/Kg	Ge (in%)	Pt
<u>Murraya koenigii</u>	S	P	+	+	+			
<u>Semecarpus anacardium</u>	S	P	+	+	+			

Pr Propagation
 S Seeds
 C Cuttings
 Su Suckers
 R Rhizomes
 St Stakes

 So Sowing
 F Furrows
 P Pits

 Sp Spacing
 + According to convenience

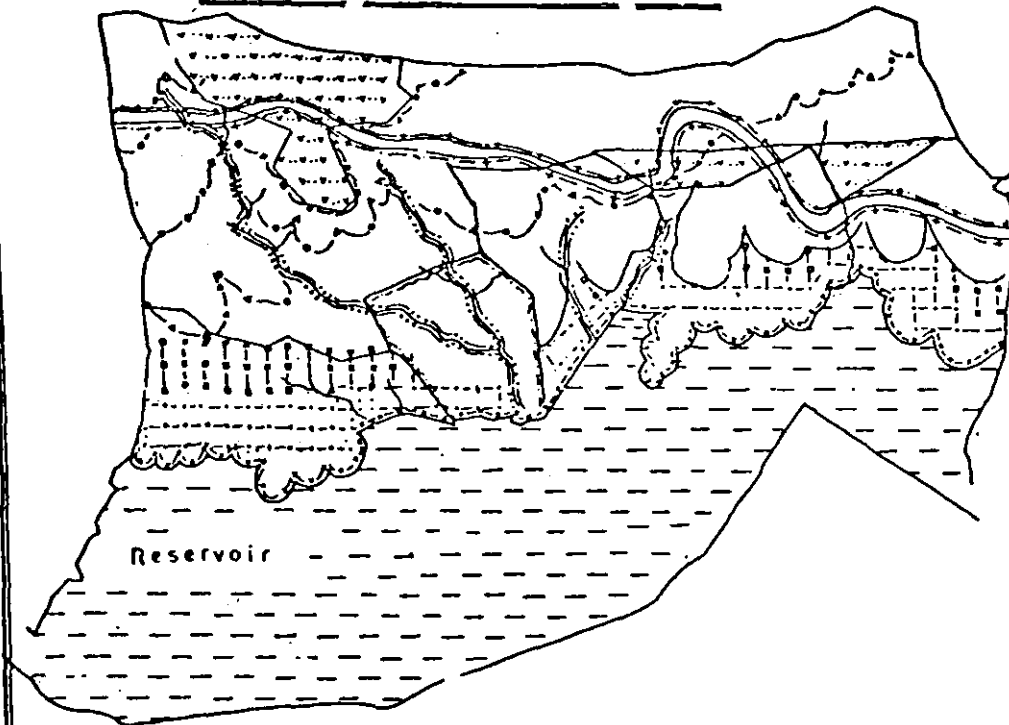
Ap : Area to be planted
 Pr : Plants required
 Sw/Kg : Seed weight / Kg
 Ge (in%) : Germination in percentage
 Pt : Pre treatment
 N : Nil

Cw-48h : Soaking in cold water for 48 hours
 Bw 5 min: Soaking in boiling water for 5 minutes
 Be-β-S-24.h: Breaking the endocarp and soaking in water for 24 hours

Not available

Map 12

KURAVATI: RE VEGETATION PLAN



First subzone

-x- Salix tetrasperma
Salix babylonica
Homongia riparia
Vitex negundo

Second sub zone

- - Morus alba

Third sub zone

⊥ Dendrocalamus strictus
 ⊕ Oxytenanthera monostigma
Terminalia alata
Phoenix sylvestris

Middle contours and gentle upper slopes

- - - - Dalbergia latifolia
Dalbergia sissoo
Terminalia alata
Bredelia squamosa
Azadirachta indica

Upper contours

•••• Erythrina variegata
Butea monosperma
Careya arborea

Streams

--- Mangifera indica
Bombax ceiba
Pongamia pinnata
Gmelina arborea
Dalbergia sissoo
Melia composita

Private farms

•• Gmelina arborea
Melia composita

•• Dichanthium annulatum
Chrysopogon montanus
Ischaemum laxum
Arundinella sp.

Fuel and fodder farms

~ ~ Leucaena leucoccephala
Dalbergia sissoo

Road side

- - - Gravelia robusta
Casuarina equisetifolia
 - - - - Gliricidia sepium
Erythrina variegata

due to the accumulation of silt from the upper slopes. The average soil depth is 30 cm.s, but in certain cases it is reaching upto 60 cm.s. Soils are normal. The average pH in the fallows is 6.31, the soluble salts content is 0.082, which indicates safe levels. The value of organic carbon is 0.724 kg/hectare, potash - 296.66 kg/hectare and phospharous - 35.733 kg/hectare. The village experiences an average annual rainfall more than 3,500 mm.s. One stream which originates in the hills of south west side after taking serpentine turns joins the reservoir near the Shirkai sacred grove. The protruded reservoir water divides the village into two parts. Villagers do not use the reservoir water (except for the two scheduled caste families) but a well near the village settlement and 4-5 springs nearby.

Vegetation: The village for the last four years has been a centre of various experiments and in fact has been choosen as a model village for development by Sahyadri Vikas Mandal, a social organization from Pune. The vegetation of the village can be divided into four categories. (a) Afforested lands by Sahyadri Vikas Mandal, (b) Sacred groves, (c) Fallows, (d) Reserved forest.

Some of the lower hill slopes taken on lease by the Sahyadri Vikas Mandal were afforested with different plant species. Their experiments are worth discussing. The different plant species that have been planted on the hill slopes are Leucaena leucocephala, Acacia auriculiformis, Tectona grandis,

Anacardium occidentale, Eucalyptus sp. and Mangifera indica. Although the survival rate of various plants is high, their growth is rather poor. Their trials with Leucaena have failed due to black-naped hare, which ate away the young leaves and destroyed most of the subabul plants. Growth of mango, cashew, teak is slow. Only the performance of Australian acacia can be considered satisfactory. In addition to the regular plantation, seed and stumps of a variety of plants were sown; but the results have not been promising mainly because of cattle menace.

The second patch of land that belongs to the Sahyadri Vikas Mandal is located on the south-west side. It is a Inam land belonging to the village deity Shirkai; no plantation programme has been carried out in this region so far. This is the only region where some tall trees are seen. A different form of shifting cultivation was practiced in this land earlier. A part of the land was given to the farmers on lease after seven years of fallow period, and ploughing was prohibited. The farmer was allowed to cultivate for only one year. The vegetation in this patch is dominated by various economically useful trees like Actinodaphne angustifolia, Embluca officinalis, Careya arborea, and Terminalia alata.

There are four sacred groves in Shirkoli. Except the Shirkai sacred grove the remaining three groves are in a very poor state of preservation. Ficus sp., Dendrocalamus strictus, Mangifera indica and Terminalia sp. are common in these groves.

The fallows are mainly dominated by Lantana - Carissa Community some other co-dominants in the fallows are Woodfordia fruticosa, Zizyphus rugosa and Embelia tsjeriam - cottam. The common trees are Terminalia alata, Syzygium cumini and Emblica officinalis. In the reserved forest area the dominant trees are Terminalia alata, Ficus sp. and Actinodaphne angustifolia. The shrub layer is of Carvia callosa on the eastern slopes and a small tree, Wrightia tinctoria is common on the western slopes.

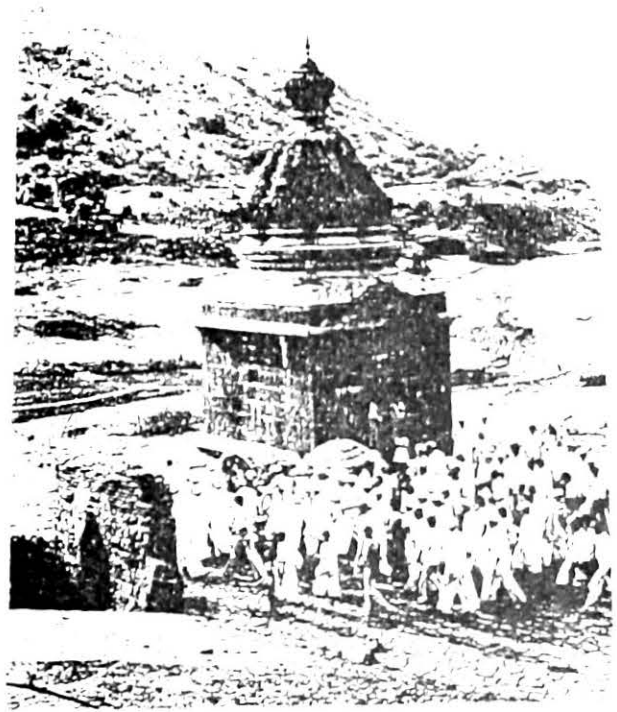
The Heritage: Shirkoli, the largest village in the Panshet catchment area is of definite historical interest. Shirkoli was settled sometime during the 14th century A.D. by Vangoji, the founder of the Raje Shirke clan. As the legend goes, he hailed from Rajputana and spent his life fighting wars. He carried his family diety, Shirkai through all the travails, and as he aged he wished to have a proper abode for Shirkai. When he was in, what is to-day the Shirkoli village, he dreamt that Shirkai wanted to settle there. That is how, as the legend goes Shirkai was established in the village which came to be named after the diety as Shirkoli. Shirkai is represented by a number of large stones. These stones are either tandalas shaped like rice grains or chiras shaped like spearhead. It is likely that the big tandalas are the original uniconic images of the mother goddesses. Shirkoli's statue represents her as Mahisasurmardini; this Kosambi hypotheses represents supplanting of the buffalo keeping Dhangars by Raje Shirke

who settled down in the extensive plains in this hilly country.

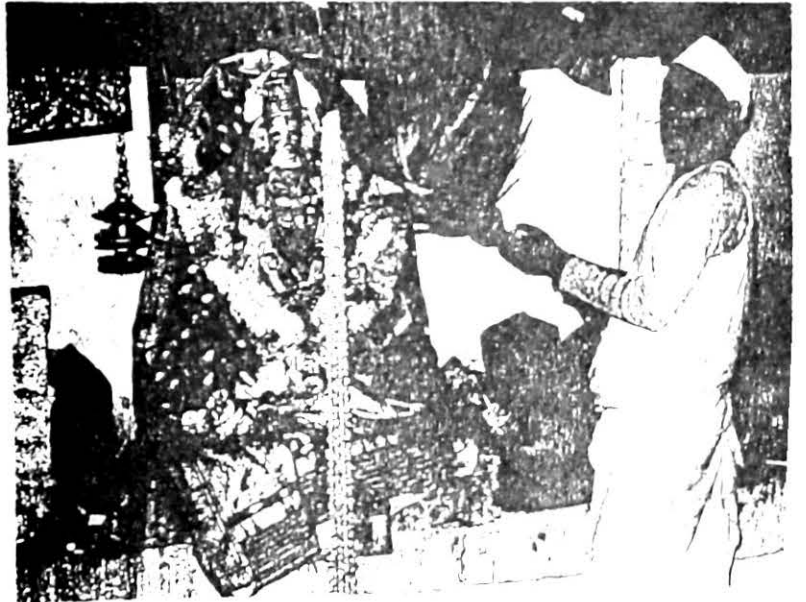
The temple got submerged in the Panshet reservoir and now the deity is lodged in a temporary shed. On the first full moon day of ~~the~~ spring (Chaitra Pournima) traditionally buffalo was sacrificed at the temple of the goddess Shirkai and then the goddess was carried in a palanquin to the bagad site. Bagad or hook swinging ritual still survives. A pair of sharp metal hooks are thrust into the back and the hooked man is left to swing from a cross bar fixed on a wooden pole. During the swinging ceremony coconut pieces are showered to bless the villagers. The ceremony is a remnant of the original human sacrifice, performed to propitiate nature to get good harvest. Every year hundreds of villagers from Ambi-Moshi and Mutha river valley attend the ceremony.

Padwal - the celebrant of bagad ceremony was in Bombay in 1979 on the day of celebration and failed to do his duty. It was reported that he lost his vision (due to the wrath of Shirkai) but somehow he reached the village, went to the temple of Shirkai and received back his vision. The age-old rituals are still observed though in a modified form and the age-old beliefs persist as the fear of the unknown is strong. Actually the life cycle - the cycle of agriculture and livestock is still largely governed by the natural elements. Even the human life, birth and the risks thereafter are largely

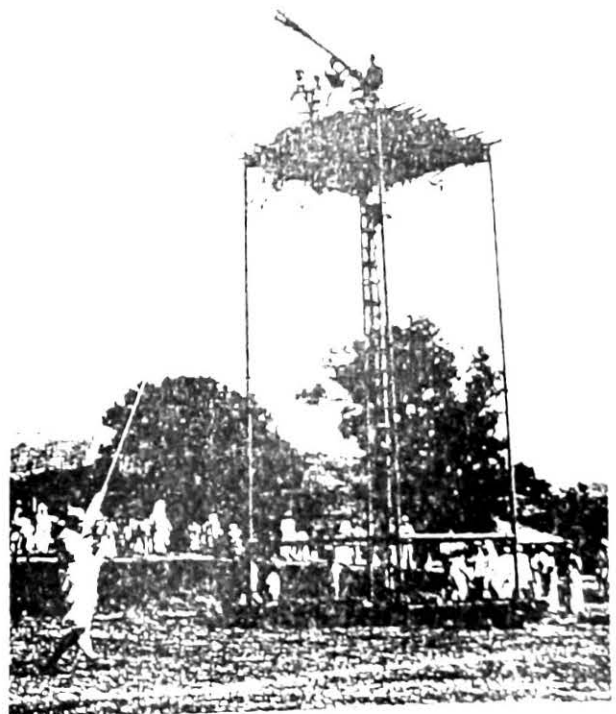
Shirkai Temple (Now Submerged
in the Lake) Goddess Shirkai
Being Carried in a Palanquin on
a Fullmoonday in Chaitra



Devacha mankari - Padwal in
Service of Shirkai



Baqad - Celebrant of Hook Swinging
Getting Ready for the Ceremony



at the mercy of the nature as basic protection and medical facilities are still lacking in this region.

But India is in a hurry to jump into the 21st century. Under the scheme of Integrated Energy Systems Shirkoli was adopted for experimentation by the University of Poona in 1985. Expensive solar panels were installed and Shirkoli over night entered into the 21st century. The T.V. set took them to all corners of the world and the tube lights (4 were installed) dispelled the darkness of the night. However the solar panels had to be dismantled within three months as the monsoon season was approaching and Shirkoli relapsed into the nineteenth century. Such ambitious schemes which do not consider the basic factors that regulate the life of the villagers and make it so hard and risky cannot take the villagers into the modern era. If the benefits of science and technology are to reach the villagers these must be applied to solve their basic economic problems.

Economic Situation: Shirkoli with 94 households or a population of 471 according to 1981 Census has as much as 1257 hectares of land. The main village where the temple of Shirkoli is located has 64 households while the Dhangar households are scattered over a number of hamlets, the largest one viz., Dangekhind has 12 households, Haralmath has 8 households, Dhamantek 4 households and the rest are in clusters of 2 households each.

Even though the geographical area is not small, the area under cultivation is only about 57 hectares according to the village records. About 14 hectares are under rice, 24 under nachani, 15 under vari and 4 under karale. Even if the encroached lands are taken into account, the land cultivated worked to about one hectare per family and in view of the low productivity of the land, it does not meet even the foodgrains requirements of the family.

All the 64 families in the main village were cultivating families, only 7 of these were landless. The landless families also cultivated land, taken on lease or encroached. All the families thus had some home-grown nachani and vari. Land under paddy varied from .04 to .4 hectare per family. The productivity of paddy varied from 10 to 25 Qn/per hectare, the average being 16 quintals/ha. Varkas land holding varied from about 2 to 20 hectares per family; the land put to cultivation in a particular year was about 10 per cent of the total varkas land. As noted above the families join together in teams pooling their land and bullock power and labour, and share the produce on the basis of land and labour contributed. There were 5 cobblers, 1 carpenter and 1 barber in the village. The traditional artisan vocation was their main occupation and agriculture was subsidiary.

According to the village records there were 226 cows, 189 bullocks and 68 buffaloes in Shirkoli. About 19000 litres

of milk was supplied to the cooperative and the estimated earnings from the sale of milk were Rs. 47,500/-. About 60 per cent of the families reported some income from the sale of mangos, jackfruit, bamboo. The income from mango averaged about Rs. 200, that from jackfruit about Rs. 150 per year per family and the income from the sale of bamboo varied from Rs. 100 to Rs. 1000, the average being Rs. 400. (See Table 5.3)

Table 5.3: Forest Produce and Fruit Marketed from Shirkoli in 1985

	Quantity (kg.)	Rate per kg.	Season	Total value (Rs.)
Mango (a)	7000	1.0-2.0	April-June	7000
Jackfruit (b)	7500	1.0	May-June	7500
Karvand	1500	1.0-1.25	April-May	1500
Amgool	150	2.0-2.5	April-May	300
Aloo	450	1.0-1.25	May	450
Apta leaves	2400	1.5	May	3600
Bamboo	6000	3/piece	Nov-May	18000
Wood	45000	.20	Nov-May	9000
Coal (c)	20000	.20	Nov-May	4000
Honey	180	15.0	March-May	2700

Notes: (a) 300 bags of raw mango could not be transported due to non-availability of truck.

(b) 20 bags of jackfruit could not be transported due to non-availability of truck.

(c) 25 tonnes of coal were confiscated.

The sources of cash income were mainly restricted to the sale of milk and fruit, bamboo, or trees (for timber or charcoal making) and seasonal wage work. The income being inadequate to maintain the family a large number of young men (sons of the heads of the family living in Shirkoli) have migrated to Bombay, Pune and are working in factories, in shops, in offices as peons, as drivers, porters. Information about the migrants is presented in Table 5.4.

Table 5.4: Migration from Shirkoli Village

Place	No. of families	No. of migrants	No. sending remittances	Total amount (monthly) (Rs.)
Bombay	16	25	11	900
Pune	16	24	10	650
Other	6	9	2	200
Total	38	58	23	1750

Thirty-eight out of 64 families from the main village had one or two members working in Bombay-Pune and 60 per cent of them were sending remittances regularly. The average annual amount worked out to about Rs. 900/- per family (sending remittances). For schooling 12 children (usually staying with their elder brothers in the city, only in Panshet they stayed in a hostel) had migrated - 4 to Pune, 2 to Bombay, 3 were in Panshet and 3 in other places.

Planning: The development plan of Shirkoli will have to take into account the heritage of Shirkoli and include in the plan, restoration of the temple of Shirkoli and its precincts and the Devrai, and re-establishment of the three other devrais dedicated to Mhasoba, Kalkai and Jingoba, which are now almost totally destroyed, and most importantly the revegetation of the denuded hill slopes and elimination of shifting cultivation so as to bring about improvements in the income of the people and restoration of ecological balance. The work must be begun forthwith; in view of the trend of young people out-migrating it might become progressively difficult to get the participation of the local people in adequate numbers. If the plan is put into action urgently and the trees get well-established then the subsequent work of after-care is lighter; the demand for labour is also limited which would not be difficult to mobilize, locally.

The village lands are divided into five categories for planning purpose. They are - (a) reservoir bank, (b) production lands, (c) protection lands, (d) backyard gardens, (e) road side.

(a) Reservoir Bank: The reservoir bank can be further differentiated into three sub-zones. The first sub-zone is a partially submerged plant-cover along the reservoir bank with a width of five metres. Species of Salix, Vitex negundo & Homonoia riparia are best suited for this sub-zone. The

next sub-zone along the reservoir bank should be a fifty metre width strip of Morus alba plantation. The lands acquired by the irrigation department, but not submerged could be utilized for this purpose. The third sub-zone from the reservoir bank should have a width of fifty metres. Bamboos together with Mangifera indica and Terminalia alata are ideally suited for this sub-zone.

(b) Production Lands: Approximately 811 hectares of grass-lands and fiftyseven hectares of cultivated lands can be used for agro-forestry programmes. This entire area of 868 hectares of private lands can be grouped into three categories.

- i) Production lands on the lower slopes (600-750 metres)
- ii) Production lands on the middle slopes (750-900 metres)
- iii) Production lands on the upper slopes (above 900 metres)

To prevent soil erosion in the initial stages a strip of green belt is necessary along the different contour lines. Once the green belt is established the farmers can grow the same trees in their farms. Gmelina arborea, Melia composita, Adina cordifolia, Careya arborea and Dalbergia sissoo would grow well on the lower gentle slopes. Excepting Careya arborea all the other trees are fast growing and the farmers will get quick returns.

The middle slopes are moderately steep and have a shallow soil cover. Terminalia alata, Bridelia squamosa, and

Anogeissus latifolia can grow well in these soils. If the soils are much disturbed due to grazing and burning, trees like Erythrina variegata, Butea frondosa, Zizyphus mauritiana and Embllica officinalis have to be grown in the initial stages to prevent erosion. The upper slopes which are above 900 metres have got shallow soils. Species of Ficus, Mallotus philippinensis, Actinodaphane angustifolia, Dillenia pentagyna on the western hill tops and Embllica officinalis and Carvia callosa on the eastern hill tops are suited.

(c) Protected Lands: 260 hectares of reserved forest and the four sacred groves have to be protected from grazing and hacking. The forest lands are located on the hill tops. The eastern hill tops belonging to the forest department are much denuded, trees are totally cut down and only herbaceous cover is present. Ficus glomerata, Ficus retusa, Erythrina variegata are suitable for planting on these denuded hill slopes. These trees can be easily propagated by cuttings and also easily establish even on shallow soils. These slopes are faraway from the village settlement and can be spared from browsing.

(d) Backyard Gardens: Some farmers are already growing various useful trees like bamboo, mango, jackfruit and Adhatoda vasica; the other farmers can be given the necessary help to grow these trees in their gardens. Grafting of Mango trees should be supported to improve the economic return.

(e) Road Side: Shirkoli is the last stop for bus service, which runs between Pune and Shirkoli during summer. For road-side planting trees like Cassia fistula, Bauhinia racemosa and Gliricidia sp are suitable. The details regarding spacing, methods of propagation etc., for the above plants are presented in Table 5.5.

Section III: Mangaon - The Haven of Climax Vegetation : Mangaon is situated on the southern side in the third zone of Tanaji Sagar dam catchment area. It occupied an area of 1086.31 hectares; out of which fifty hectares were acquired by the irrigation department. The terrain is rugged, interspersed by undulating hills and deep valleys. The highest peak is located on the south-east side at an altitude of 1088 metres. The slopes are steep; about 75 per cent of the land exhibits higher than 20° slope. Table lands are occasionally seen. After the construction of the dam the village settlement has shifted to one of such table lands. The village falls in a high rainfall zone, which experiences an average of more than 5,000 mm.s of rain fall per year. Three streamlets origin at the tops of hills and finally joining below the sacred grove form a small stream. The stream is about one metre depression that provides water for washing clothes and drinking water to the cattle during summer. An adjoining well on the left bank of the stream, although unhygeinic is the only source of drinking water to the entire village of Mangaon during summer. The village suffers from the shortage of water during the summer months as the reservoir dries up during this period.

Tab 55 PLANT SPECIES SUITABLE TO SHIRKOLI AND APPROPRIATE METHODS OF PROPAGATION

Plant name	Pr	So	SP	Sw /Ka	Ge (in%)	Pt
First sub zone along the Reservoir bank						
<u>Homonoia riparia</u>	S	F	1m×1m	—	—	—
<u>Salix babylonica</u>	C,Su.	F	"	—	—	—
<u>Salix tetrasperma</u>	C,Su	F	"	—	—	—
<u>Vitex negundo</u>	C	F	"	—	—	—
Second sub zone along the re reservoir bank						
<u>Morus alba</u>	C	F	3 _m ×3 _m	—	—	—
Third sub zone along the reservoir bank						
<u>Dendrocalamus strictus</u>	R,S,St.	P	6 _m ×6 _m	55.000	80-90	N
<u>Oxytenanthera monostigma</u>	R,S,Sf	P	"	"	"	N
<u>Mangifera indica</u>	S	P	12 _m ×12 _m	8-10	90	N
<u>Terminalia alata</u>	S	P	"	400 fruits	40-50	Cw48h

Plantname	Pr	So	SP	Sw/Kg	Ge (in%)	Pt
Along lower contours						
<u>Adina cordifolia</u>	S	P	2m×2m	11800,000	30-40	N
<u>Careya arborea</u>	S	P	"	7-10	-	N
<u>Dalbergia sissoo</u>	S,Su	P	"	14,000pods	80	N
<u>Gmelina arborea</u>	S	P	"	1000kernels	80-90	N
<u>Melia composita</u>	S	P	"	1700	-	Be. BS. 24h
Along the middle contours						
<u>Anogeissus latifolia</u>	S	P	2m×2m	120,000	20-30	N
<u>Bridelia squamosa</u>	S	P	"	-		N
<u>Butea monosperma</u>	B,Su	P	"	1,800	90	N
<u>Emblica officinalis</u>	S	P,F	"		90	N
<u>Erythrina variegata</u>	S,St	P,F	"	2000	50-60	N
<u>Terminalia alata</u>	S	P	"	400fruits	40-50	N
<u>Zizyphus mauritiana</u>	S	P	"	1500	60-80	N

Plant name	Pr	So	SP	Sw/Kg	Ge (in %)	Pt
Along the upper contours						
<u>Actinodaphne angustifolia</u>	S	P	2m x 2m	+	-	-
<u>Carvia callosa</u>	S	F	1m x 1m	-	-	-
<u>Dillenia pentagyna</u>	S	P	2m x 2m	-	-	-
<u>Emblica officinalis</u>	S	P.F	"		90	N
<u>Ficus glomerata</u>	C	P.F	6m x 6m	-	-	N
<u>Ficus retusa</u>	C	P.F	"	-	-	N
<u>Mallotus philippinensis</u>	S	P	2m x 2m	-	-	-
Road side						
<u>Bauhinia racemosa</u>	S	P.F	2m x 2m		80	N
<u>Cassia fistula</u>	S	P.F	"	5500	65	Bw 5min
<u>Glyricidia sepium</u>	S, St	P.F	"		80	N
Shrubs						
<u>Carissa congesta</u>	S	F	1m x 1m	-	-	N
<u>Meynea laxiflora</u>	S	F	"	-	-	N

Plant name	Pr	So	SP	Sw / Kg	Ge (in%)	Pt
<u>Zizyphus rugosa</u>	S	F	-	-	-	N
House gardens						
<u>Adhatoda vasica</u>	S	F	†			
<u>Artocarpus heterophyllus</u>	S	P	+			
<u>Dendrocalamus strictus</u>	RSSt	P	+	55 000	80-90	N
<u>Mangifera indica</u>	S	P	+	8-10	90	N

Pr: Propagation

S - Seeds

C - Cuttings

Su - Suckers

R - Rhizomes

St - Stakes

So: Sowing

F - Furrows

P - Pits

Sp: Spacing

† - According to convenience

Sw / Kg: Seed weight / Kg

Ge (in%): Germination in percentage

Pt: Pre treatment

N - Nil

Cw-48h - Soaking in coldwater for 48 hours

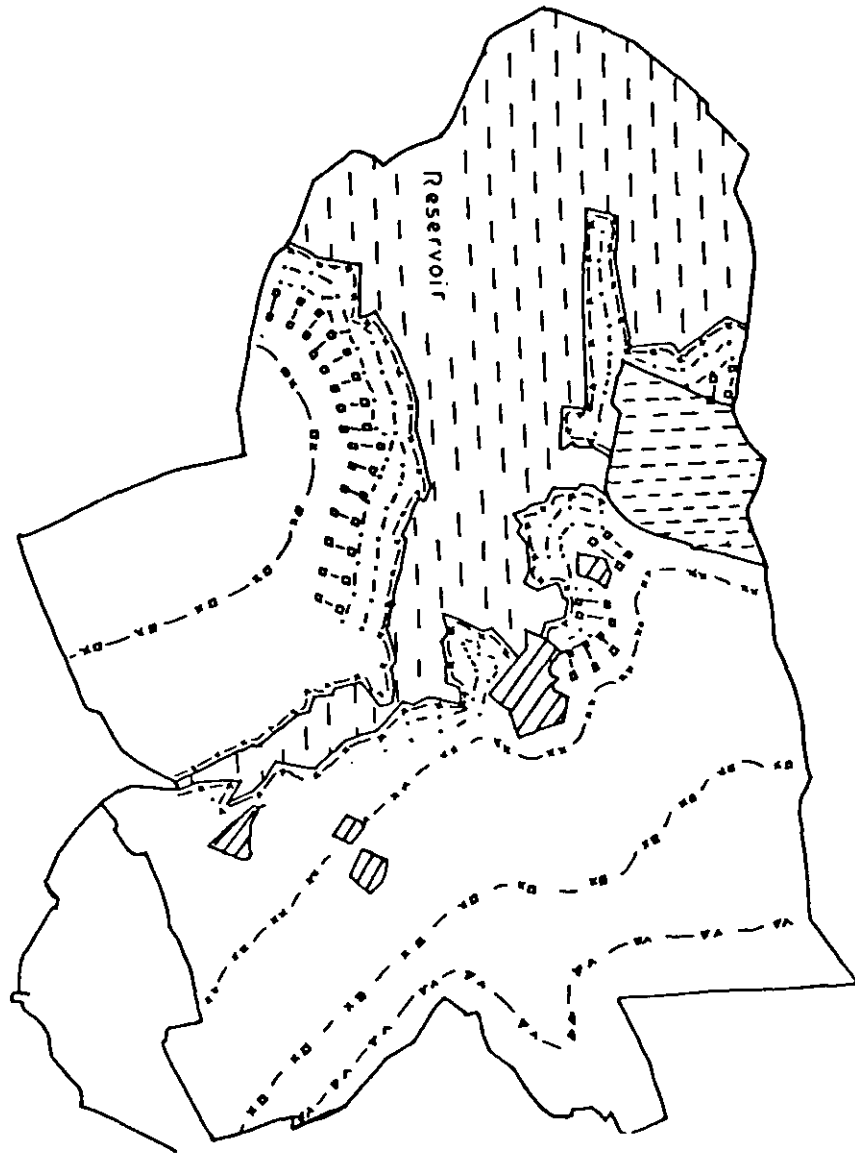
Bw 5min - Soaking in boiling water for 5 minutes

Beß 24h - Breaking the endocarp and soaking in water for 24 hours.

- : Not available

Map-13

Shirkoli Re vegetation plan



First sub zone

- - - Salix babylonica
- - - Salix tetrasperma
- - - Vitex negundo
- - - Homonioia riparia

Second sub zone

- - - Morus alba

Third sub zone

- Dendrocalamus strictus
- Oxytenanthera monostigma
- Terminalia alata
- Mangifera indica

Lower contour lines

- - - - Gmelina arborea
- - - - Melia composita
- - - - Adina cordifolia
- - - - Careya arborea
- - - - Dalbergia sissoo

Middle contour lines

- - - - Terminalia alata
- - - - Bridelia squamosa
- - - - Anogeissus latifolia
- - - - Erythrina variegata
- - - - Butea monosperma
- - - - Zizyphus mauritiana
- - - - Emblica officinalis

UPPer contour lines

- - - - Ficus retusa
- - - - Ficus glomerata
- - - - Mallotus philippinensis
- - - - Actinodaphne angustifolia
- - - - Dillenia pentagyna
- - - - Emblica officinalis
- - - - Carvia callosa

Plantation areas of sahyadri
Vikas Mandal

- - - Mangifera indica
- - - Eucalyptus.sp
- - - Acacia auriculiformis
- - - Leucaena leucocephala
- - - Anacardium occidentale

House gardens

- ≡ Dendrocalamus strictus
- ≡ Mangifera indica
- ≡ Adhatoda vasica
- ≡ Artocarpus heterophyllus

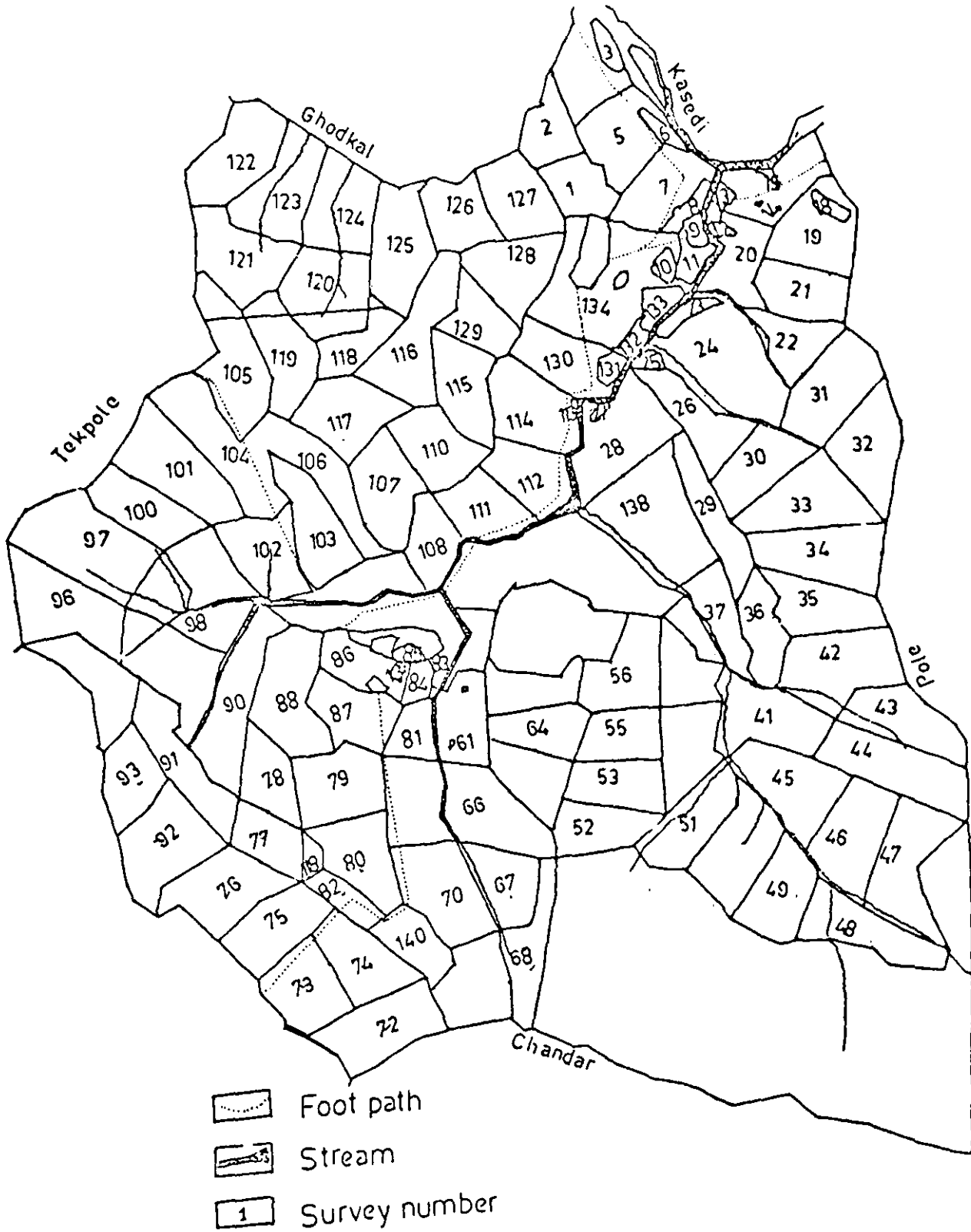
The soil depth varies from place to place. The hills near the village show soil depth of more than 12 cm., while the hill tops facing the south-west side have got only a thin layer of soil cover. pH and soluble salts are the only parameters studied. The average pH is 5.7, while on the hill tops it is 5.4; soils are relatively acidic, soluble salts are in safe levels in all the places studied.

Vegetation: The vegetation of Mangaon can be examined for three categories of land uses viz., (a) fallows, (b) reserved forests and (c) sacred grove. The vegetation of fallows is much influenced by the agricultural practices. Often economically useful trees like Butea monosperma, Terminalia bellerica and Terminalia chebula are seen as these trees are left uncut even when a plot is cleared for cultivation. Other than the above mentioned trees certain shrub species like Woodfordia fruticosa, Carissa congesta and Lasiosiphon eriocephalus is a predominant shrub community on the low hills. While Meynea laxiflora, Casearia graveolens, Xeromphis spinosa and Colebrookea oppositifolia is the dominant shrub community on the high hills. Crinum latifolium is common on the open high hills, which appears before rains in the burned fallows.

Forest lands near the village are much degraded, but the faraway forest patches, which are inaccessible are moderately protected, and still hold some vegetation. The

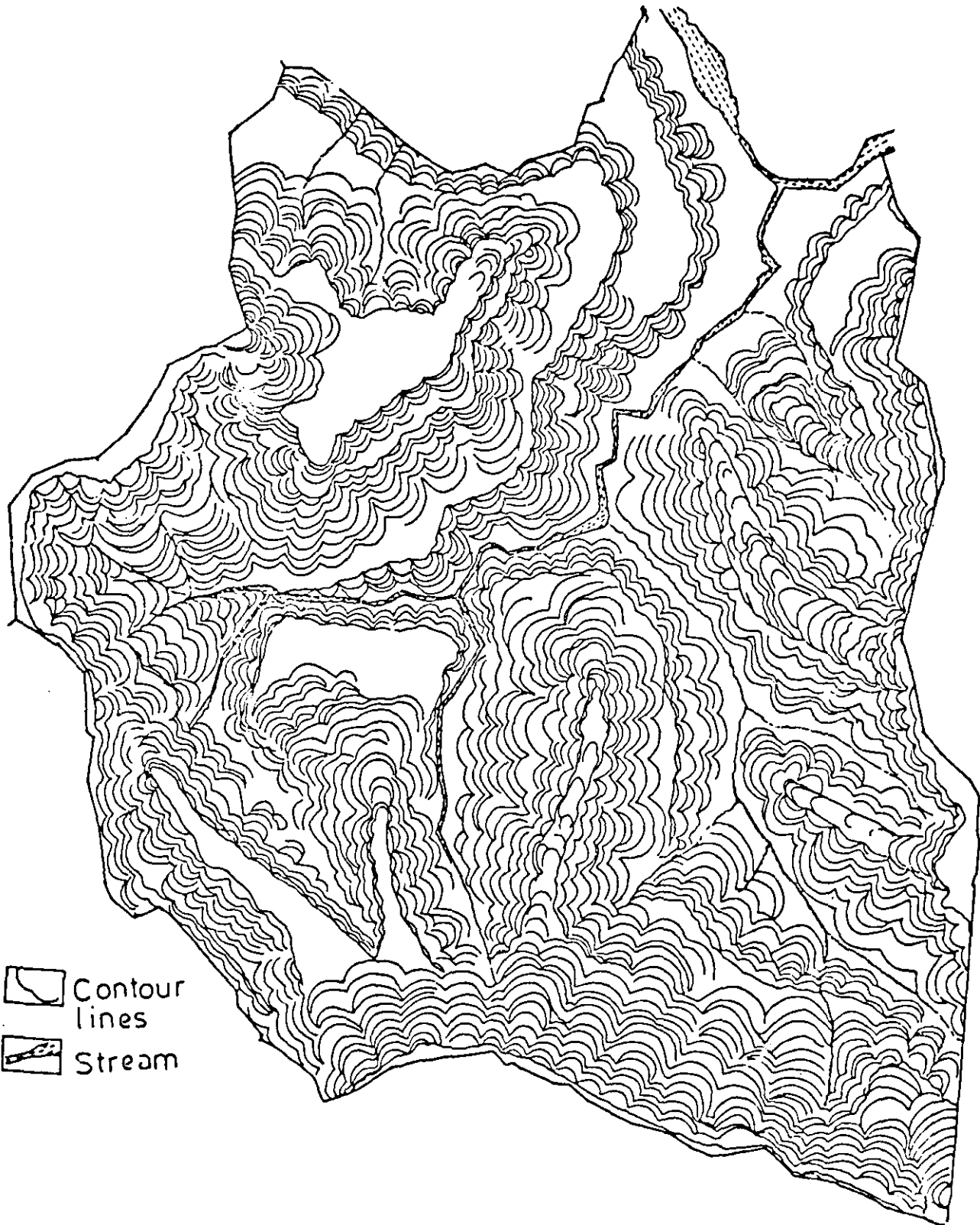
Map 14

Mangaon village map (Before the construction of the dam)



Map. 15

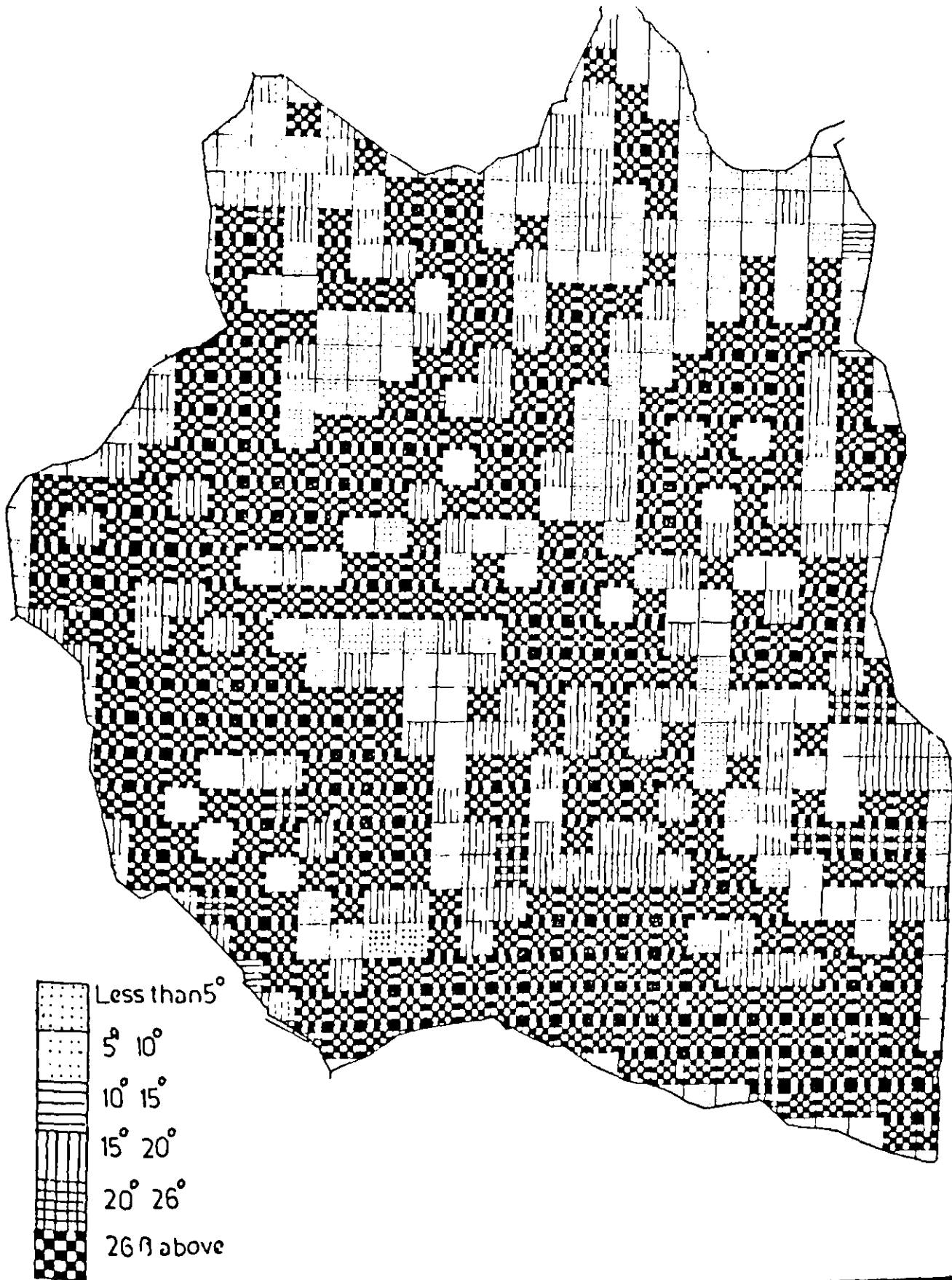
Contour map of Manganon (Before the construction of the dam)



Map.16

Slope map of Mangaon

(Before the construction of the dam)



predominant tree community is Memecylon umbellatum and Syzygium cumini and the other co-dominant is Glochidion hohenackeri. The frequently occurring shrubs are Woodfordia fruticosa, Allophyllus serratus and Meynea laxiflora.

The sacred grove of Janni, although it belongs to the forest department is preserved due to religious beliefs. Vartak & Gadgil (1981) have collected a total number of 76 plants species belonging to angiosperms. Vegetationwise the peripheral region of the sacred grove is dominated by species of Memecylon umbellatum, Syzygium cumini and Terminalia sp. The centre core of the sacred grove is dominated by trees like Xylia dolabriformis, Dysoxylum binectariferum and Syzygium cumini, and also climbers like Gnetum ula and Diploclasia sp. are very common.

Economic Activity: The population of Mangaon according to the 1981 Census was 369 persons. The geographical area is 1016 hectares of which 300 hectares belong the forest department, and about 125 hectares are under cultivation. In 1983, according to the village records, 14 hectares were under rice. The land under shifting cultivation was 110 Ha., of these 44 hectares were under nachani, 41 hectares under vari, 15 hectares under karale and about 10 under sawa. In addition there was some encroachment of the forest lands. Leaching of mineral nutrients makes it necessary to leave the land fallow after about three years of cultivation. The fallow period

ranges between 5 to 7 years. The growth of stump and weed, including the spread of deep rooted and fire tolerant varieties of weeds, restricts the crop growth. The productivity varied considerably from plot to plot depending upon the soil depth, type of soil, weed menace and cultural practices. As the agricultural production is not adequate to meet even the bare subsistence needs of the families, considerable out-migration was noted. In half the families one of the sons (two sons in 25 per cent of the migrant families) had migrated; of the migrants 75 per cent were in Bombay and 25 per cent in Pune. They were mainly working in textile and oil mills, in restaurants, as rikshaw or truck driver, as porter. Regular remittances were reported only by 1/7 of the families,

Mangaon village is not accessible by road. The road reaches only upto Shirkoli on the southern bank; the distance to Mangaon from Shirkoli is about 11 km. The launch also cannot reach Mangaon after April. The villagers have to walk across the lake-bed to Gondekhal about 5 km where bus service (once a day) is available between January to May. There is only one grocery shop and two blacksmiths and two barber families in the village. The villagers have to go to Panshet township for all the other purchases and services. Except for the sacred grove, the vegetation is quite sparse and the villagers complained that they have to carry brushwood from over long distance and that too of a poor quality.

According to the village records there were 146 cows and 103 bullocks in Mangaon and only 28 buffaloes. In 1984, the milk sales from Mangaon fetched an income of about Rs.61,000. In addition there were 116 goats, maintained mainly by the Dhangar families. Grazing land is overexploited and the villagers complained that the quality of grass is poor. Private contractors buy ran (the plot to be cleared for shifting cultivation) or trees for making charcoal and export charcoal to Pune by truck. Similarly bamboo is sold in a considerable quantity. Small quantity of hirda, and apta leaves are also exported. The villagers depend largely on the EGS works for cash income. All the families join the road works opened up under the EGS in summer. The wage rates in 1984 were reported to be Rs. 4 to Rs. 5 per day. The hardship and poverty is thus crushing. As a result there is undernourishment. In addition it was noted that at the source of water supply - cattle is cleaned, clothes are washed and the water gets polluted. Incidence of diarrhoea and fever (particularly malaria) was reported to be considerable and child mortality very high. Nearly sixty per cent of the families reported deaths of children, most of whom died upto the age of 2-3. Infant mortality rate worked to about 200 per 1000 children. About 30 per cent of these were still births. The major causes of death were diarrhoea and fever. Deaths due to chicken pox and rickets were also reported. Besides the problem of mal-nourishment and polluted water supply, little medical aid is

available in this remote village. If the home-remedies or charms of traditional medicine man - Bhairi do not work the children succumb.

Development Plan: The development plan for the village has thus to address the following basic problems (i) Improvement in the resource base through better use of the land resources of the village, (ii) provision of regular wage employment to the villagers in the work of development of the natural resource base, (iii) provision of protected drinking water supply, (iv) regular launch service and medical service. For preparing the development plan for Mangaon, the village lands are divided into six categories. (a) Reservoir bank, (b) Production lands, (c) Protected lands, (d) Streams, (e) Backyard gardens, (f) Sacred grove.

(a) Reservoir Bank: The reservoir bank can be further divided into four sub-zones. The first sub-zone from the highest water level of the reservoir bank will be a strip of five metres width plant-cover of the plants that grow in the partial submergence region. Plants that are suited for this sub-zone are Salix babylonica, Vitex negundo and Homoroia riparia. Species of Salix and Vitex can be easily propagated by cuttings.

The second sub-zone from the reservoir bank will be a strip of 30 metres width. Shikekai (Acacia rugata) - an

extensively climbing shrub armed with numerous prickles mixed trees like Mangifera indica and Syzygium cumini with a 10m x 10m space are suitable for this sub-zone. Shikekai has got considerable economic value. The third sub-zone along the reservoir bank should be a 50 metres with strip of mango and bamboo plantation with a spacing of 6m x 6m. The fourth sub-zone along the reservoir bank will be a strip of 50 metres width to be planted exclusively with timber value trees, with a spacing of 3m x 3m. The tree species suitable for this sub-zone are Alstonia scholaris, Anthocephalus cadamba, Olea dioica and Cordia dichotoma.

(b) Production Lands: These lands today are under shifting cultivation that needs to be discontinued. This can be achieved when reforestation plan is properly implemented and forestry based skills are encouraged; activities like bee-keeping, lac making, collection of medicinal herbs and its primary processing and also making charcoal from suitable trees are possible in this zone. Choice of suitable trees and shrubs and growing them on the submarginal lands at different places need a careful study of slopes, latitude and various characters of plants. On the basis of the present study an indicative list of the plants suited for this purpose is given in Table 5.6. For systematic development of this area rectangulation of present odd shaped individual farms with a width of 200-250 metre along the contour lines is essential.

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Tab 56 PLANT SPECIES SUITABLE TO MANGAON AND APPROPRIATE METHODS OF PROPAGATION

Plant name	Pr	So	Sp	Sw / Kg	Ge (in%)	Pt
Reservoir bank						
The first sub zone along the reservoir bank						
<u>Homonoia riparia</u>	S	F	1 _m × 1 _m	—	—	—
<u>Salix babylonica</u>	C,Su	F	"	—	—	—
<u>Salix tetrasperma</u>	C,Su	F	"	—	—	—
<u>Vitex negundo</u>	C	F	"	—	—	—
The second sub zone along the reservoir bank						
<u>Acacia rugata</u>	S	F	1 _m × 1 _m	—	—	—
<u>Mangifera indica</u>	S	P	12 _m × 12 _m	8-10	90	N
<u>Syzygium cumini</u>	S	P	"		70	N
The third sub zone along the reservoir bank						
<u>Dendrocalamus strictus</u>	R,S,St	P	6 _m × 6 _m	55 000	80-90	N
<u>Oxytenanthera monostigma</u>	R,S,St	P	"	55 000	80-90	N
<u>Mangifera indica</u>	S	P	12 _m × 12 _m	8-10	90	N

Plant name	Pr	So	Sp	Sw/Kg	Ge (in%)	Pt
Fourth sub zone along the reservoir bank						
<u>Alstonia scholaris</u>	S	P	3m x 3m			N
<u>Anthocephalus cadamba</u>	S	P	"	Several thousands	25	N
<u>Cordia dichotoma</u>	S	P	"			
<u>Olea dioica</u>	S	P	"			N
Along the middle contours						
<u>Dysoxylum binectariferum</u>	S	P	2m x 2m		70-80	N
<u>Lagerstroemia lanceolata</u>	S	P	"			
<u>Terminalia bellerica</u>	S	P	"	500 fruits	85-95	N
<u>Terminalia chebula</u>	S	P	"	150 dry fruits	40-50	Cw 48.h.
<u>Xylia dolabriformis</u>	S	P	"		70-80	N
Along the upper contours						
<u>Actinodaphne angustifolia</u>	S	P	2m x 2m			
<u>Ficus</u> Sp	C	P	"			N
<u>Memecylon umbellatum</u>	S	P	"			

Plant name	Pr	So	SP	Sw /Kg	Ge (in%)	Pt
<u>Syzygium cumini</u>	S	P	2 _m x 2 _m			N
Along streams						
<u>Heterophragma quadrilocularis</u>	S	P	2 _m x 2 _m			
<u>Memycylon unbellatum</u>	S	P	"			
<u>Pongamia pinnata</u>	S	P	"	15 00	75	Cw 48.h.
Shrubs						
<u>Emblica officinalis</u>	S	P,F	1 _m x 1 _m			N
<u>Meynea laxiflora</u>	S	P,F	"			N
<u>Murraya koenigii</u>	S,Su	P	"			
House gardens						
<u>Artocarpus heterophyllus</u>	S	P	+			
<u>Dendrocalamus strictus</u>	S,R,S	P	+	55 000	80 90	N
<u>Mangifera indica</u>	S	P	+	8-10	90	N

Pr: Propagation

S - Seeds

C - Cuttings

Su - Suckers

R - Rhizomes

St - Stakes

So Sowing

F - Furrows

P - Pits

Sp Spacing

+ According to
convenience

Sw / Kg : Seed weight /Kg

Ge (in%): Germination in percentage

Pt: Pre treatment

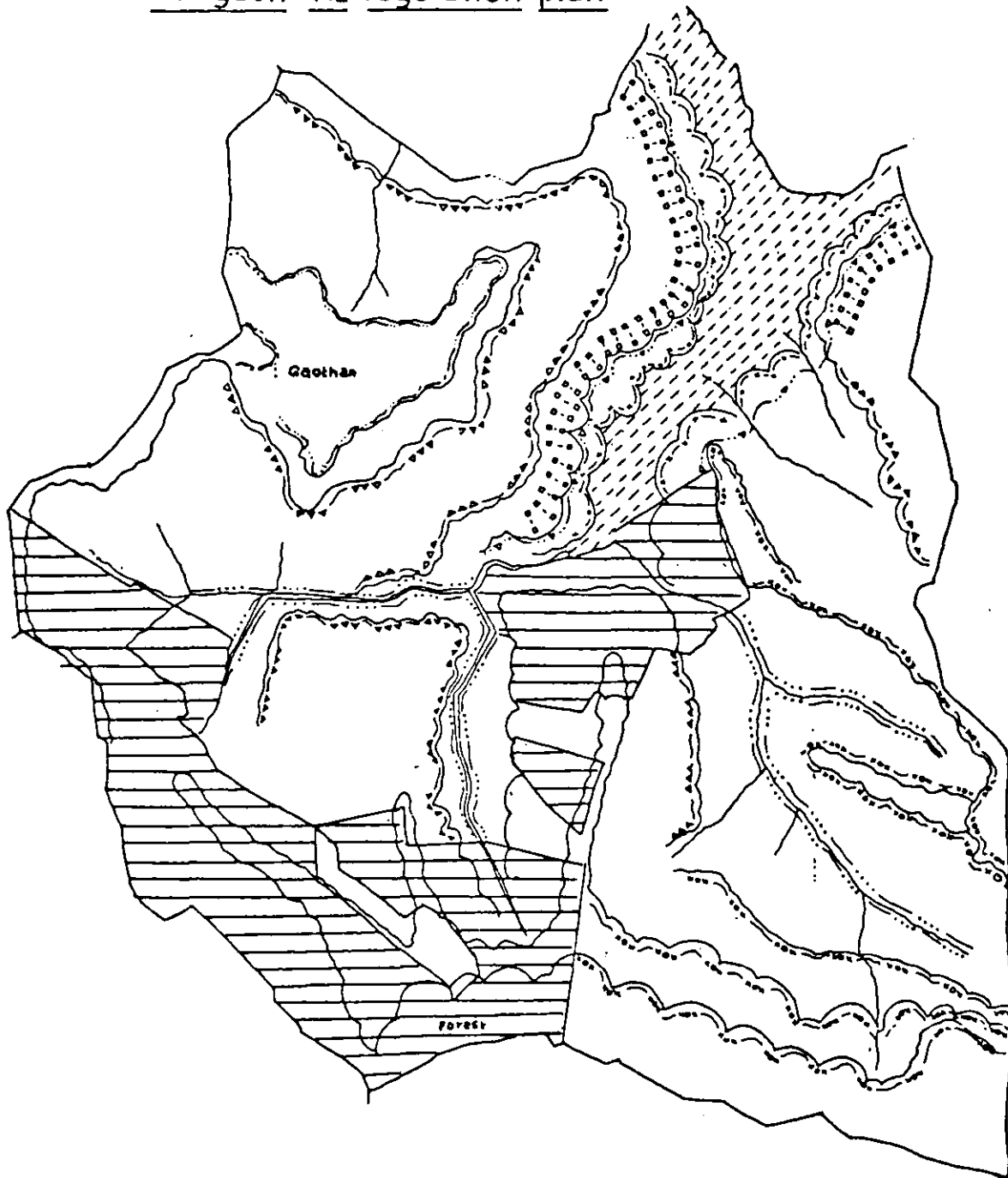
N : Nil

Cw.48h - Soaking in coldwater
for 48 hours

- : Not available

Map.17

Mangaon : Re vegetation plan



Reservoir bank

First sub-zone

- Salix babylonica
- Vitex negundo
- Hemoria riparia

Second sub-zone

- Acacia rugata
- Mangifera indica
- Syzygium cumini

Third sub-zone

- Dendrocalamus strictus
- Mangifera indica

Fourth sub-zone

- Alstonia scholaris
- Anthocephalus cadamba
- Olea dioica
- Cordia dichotoma
- Murraya koenigii

Middle contours

- Terminalia bellerica
- Terminalia chebula
- Lagerstroemia lanceolata
- Dysoxylum binectariferum
- Xylia dolabriformis

Upper contours

- Memecylon umbellatum
- Syzygium cumini
- Ficus sp
- Actinodaphne angustifolia
- Wrightia tinctoria

Streams

- Memecylon umbellatum
- Pongamia pinnata
- Heterophragma quadriloculare

House gardens

- Dendrocalamus strictus
- Artocarpus heterophyllus
- Mangifera indica

Strip planting along the contour with each strip having three layers of canopy, and the ground layer of suitable grasses will be an effective measure for controlling the speed of the runoff. It will help water conservation and soil conservation.

The first two layers of canopy from the top should have various useful timber, fodder and fuel producing species and the third layer should preferably have fruit plants, mostly dominated by shrubs and a few small trees, and the ground layer should have grasses like Isachium and Arundinella. Even if a strip is cut for marketable materials the other strips would help check the soil erosion. The production lands should be in a position to fulfill the individual farmers' fuel requirements and supply of tree-leaf fodder to the cattle. It should also be able to produce enough quality timber for sale.

For planting along the contour lines of the middle slopes Terminalia bellerica, Terminalia chebula, Lagerstroemia parviflora, Dysoxylum binectariferum and Xylia dolabriformis are best suited. Memecylon umbellatum, Ficus sp and Syzygium cumini can thrive well on the upper slopes, where the poor shallow soils will be a controlling factor for other plants.

(c) Protected Lands: The lands that have to be protected are a patch of denuded hill slopes of 100 hectares that belong to the farmers and about 300 hectares of forest land. Barking deer, mouse deer, porcupines and many birds are still surviving

in the faraway forest patches. Trees like Erythrina variegata, Anogeissus latifolia, Anthocephalus cadamba, Ficus retusa, Butea monosperma can be grown along the contour lines. These trees should not be cut but can be lopped for tree-leaf fodder.

(d) Streams: In Mangaon, trees are not seen along the stream banks but shrub cover is there. Trees like Memecylon umbellatum Pongamia pinnata, Heterophragma quadrilocularis, which are already growing in a limited number can be propagated in two rows along the streams.

(e) Backyard Garden: Trees suited for backyard garden are jackfruit, mango, bamboo, cashewnut; cottage fruit processing in summer can provide some supplementary employment and income.

(f) The Sacred Grove: The sacred grove must be fully protected from all kinds of interference to preserve the biotic diversity. Gadgil & Vartak's (1973, 1976) observations during their study supports the Kosambi's hypothesis, that the Janni sacred grove belongs to the hunting-gathering stage of society. Worship of mother goddess with animal sacrifice and the location of the grove away from the village support this view. Apart from the antiquity of the grove, the sacred grove of Janni is the only grove that occupies a large area, and also this is the only grove in the catchment area with a number of plant species that exhibits the climax form of vegetation. A striking example of the importance of this grove is the presence of

certain useful plant species. Notable amongst them is Xylia dolabriformis which has disappeared from the nearby areas (Gadgil & Vartak, 1976).

Section IV: Zone IV - A Fragile Eco-system : The fourth zone comprising three villages viz., Tekpole, Kuratwadi and Dapsare is located further towards the west, at the fringe of the Western Ghats. The summits of the hills are still inaccessible; after a sheer drop of 1000 metres, the hill ranges meet Konkan, a low lying plain between the foot of the Western Ghats and the Arabian sea. The terrain is very irregular, table lands are generally more common. Various streams originate on these high hills and passing through the narrow valleys, finally join at Tekpole. The fourth zone which is the source region of river Ambi, receives very heavy rainfall; the average annual rainfall ranges between 6000-9000 mm. Intensive shifting agriculture has brought about considerable changes in the soil cover. Rock is exposed at many places due to shifting agriculture. The chemical analysis of the soils of fallows shows that soils are acidic. The average pH is 5.48; soluble salts are below 0.15, indicating the safe levels. However, as compared to zones I to III increase of organic carbon and potash contents is noticed. Organic carbon is 0.832 kg/hectare, and potash - 384.20 kg/hectare, while the phosphorus content is slightly less than that noted in the 1st zone. The average phosphorus in the fallows is 14.2 kg/hectare.

The fourth zone with a variety of habitants deserves a special mention. The hill slopes are splendid with a variety of plant, animal and bird species. Other than these a few islands of sacred groves embellish the zone. However, hacking of trees and encroachment of forest lands has brought about many changes in the recent years. Due to the absence of real forest many animals have vanished from the region, especially the carnivora are the first to disappear due to the scarcity of prey animals and also due to the lack of proper habitat. As a result tigers and bears are totally absent, but leopard visits occasionally. Jackals, hyenas and mongooses are common in the forest. Large mammals like wild boar, and barking deer are restricted to the reserved forest area. Mouse deer, a threatened animal is occasionally seen in the remote forest lands. Rhesus macaque is common on the cliffs of Western Ghats in Dapsare. Among the birds Brown wood owl is seen in the sacred grove of Dapsare, while Brown fish owl and Grey Jungle fowl are common in the fallows as well as reserved forest.

Vegetation: The fourth zone is unique. Here topography, soil depth and rainfall are playing major role in controlling the vegetation; there is no dominant plant community, certain plants dominate a limited space. Climax form of vegetation is not seen in any locality not even in the sacred groves. The vegetation of the fourth zone can be broadly classified into

three categories, (a) Vegetation on the high hills or upper slopes, (b) Vegetation on the lower slopes, (c) Vegetation along the streams.

It is evident from the study that the tree species are more or less soft-wooded and some times buttressed. Memecylon umbellatum and Syzygium cumini mixed with bamboo is the dominant plant community on the upper slopes. A thick undergrowth of shrubs like Strobilanthus is noticed in the reserved forest area while on the middle slopes which mostly belong to the farmers Actiondaphne angustifolia, Glochidion hohenackeri is the dominant tree community in Dapsare. On the Western slopes Phoenix humilis is very common. The dominant shrubs community is Woodfordia fruticosa and Lasiosiphon eriocephalus.

Along the streams the vegetation changes considerably, where tall trees of 30 metres are often seen. The common trees along the streams are Memecylon umbellatum, Ficus sp., Mangifera indica and Syzygium cumini. Some other trees like Pongamia pinnata, Sterculia foetida, Alstonia scholaris are occasionally seen.

A total number of eight sacred groves were recorded from the fourth zone. Three out of them belong to Tekpole and five are from Dapsare. The sacred groves in Tekpole are well

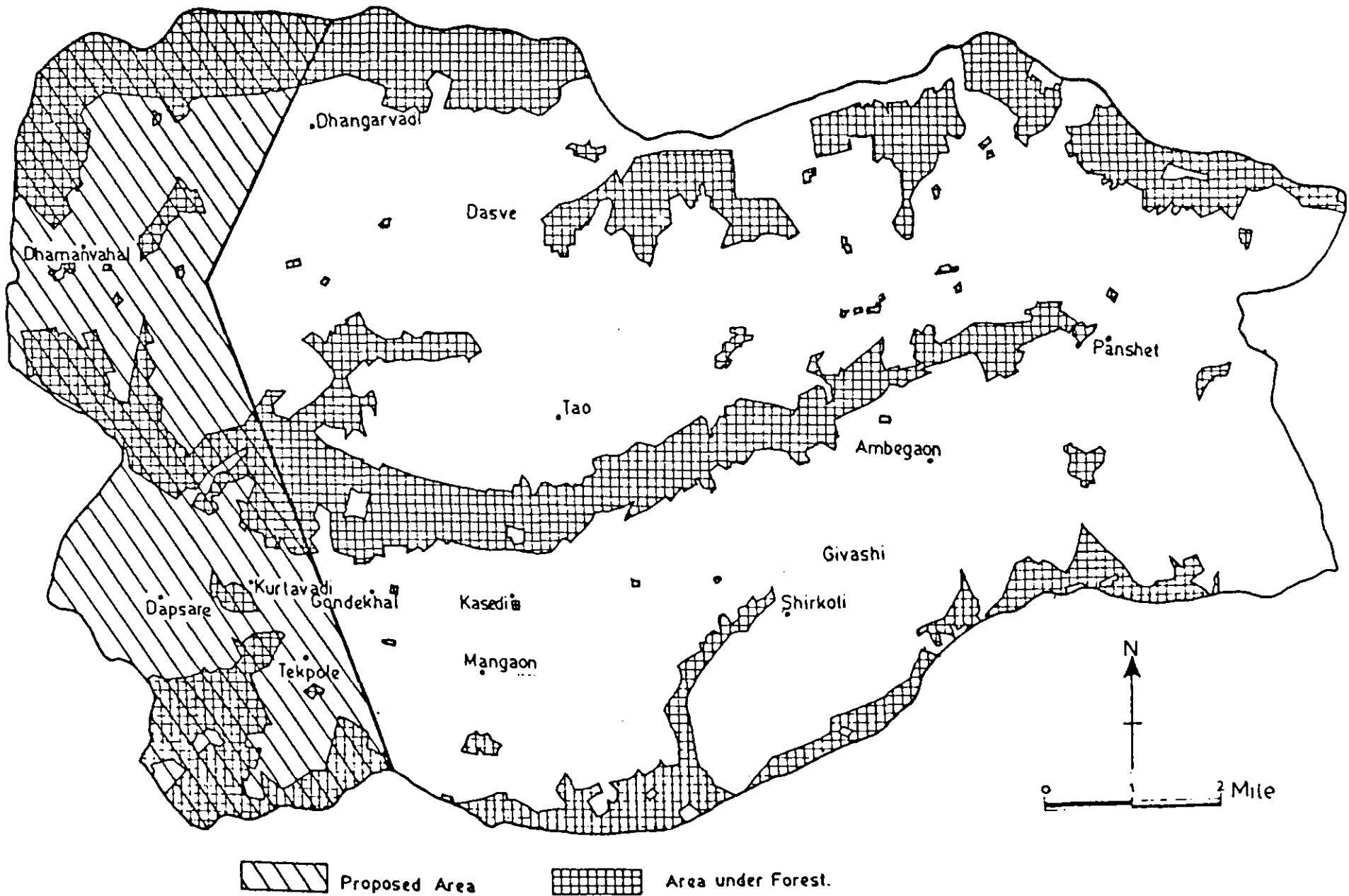
preserved while the sacred groves in Dapsare are moderately preserved. Species like Sterculia guttata, Celtis cinnamomea, Dysoxylum binectariferum, Bassia longifolia are seen only in the sacred groves. Other than these, species of Strobilanthus and Ixora nigricans are seen only in the fourth zone. Much of this region still needs botanical explorations.

A Special Reserve: The fourth zone is a very fragile ecosystem, hence needs much protection. The flora and fauna of this zone appear to be very sensitive to interference and once they are destroyed due to the influence of biotic factors it is difficult to reestablish them. Consequently the zone is becoming biologically barren. Once the vegetative cover is lost the torrential rains wash away the top soil. As a result bare rocks are visible at many places. These processes must be reversed and reversed urgently. It is therefore suggested to fully protect this zone as a wildlife sanctuary. The sanctuary should extend over the crestline and the adjacent areas of very high rainfall. There are only three villages in this zone with 144 households. The local residents cultivate some paddy and nachani, but they hardly have any other sources of income as the villages are almost inaccessible for most of the months in an year. Wage employment and sale of fruit, milk are difficult. The main source of cash income is therefore the sale of trees for making charcoal that is transported in truck which alone reaches these interior villages from

January-May. It is also difficult and very costly to provide basic infrastructural facilities to these villages. The villagers indicated their willingness to shift if jobs are provided and proper rehabilitation is effected. They can be resettled near Panshet-Kuran on lands acquired by the irrigation department. They can be organized into a milk cooperative. The cattle may be stall-fed with good quality forage produced locally. Other activities proposed to be established at Panshet, e.g. silk-worm rearing, basketry, tile making, fruit processing, wood working (on soft wood of Mulberry, *Salix* sp.s) can also provide some employment.

The protected zone can be extended to the adjacent Moshi valley also. The area of proposed sanctuary would then be about 55 sq.km.s. (See Map 18) This protected zone will provide protection to the rare species of plants from the semi-evergreen and evergreen biotype, and also rehabilitate a number of animal species that are fast disappearing from the Western Ghats. Such species include *Xylia dolabriformis*, *Hippocratea grahami*, *Plectronia wightii*, *Ixora nigricans*, *Bassia longifolia*, *Alstonia scholaris*, *Vallaris heynei*, *Dysoxylum binectariferum*, *Celetis cinnamomea*, *Sterculia foetida* and *Litsea zeylanica*. It will protect populations of barking deer, Indian porcupine, jackal, leopard, and colourful, locally restricted bird species such as crested serpent eagle, grey jungle fowl, brown wood owl, brown fish owl, crested tree swift, scarlet minivet, black bulbul; a number of fly catchers and sunbirds & vibrantly

PANSHET AND WARASGAON CATCHMENT: PROPOSED WILDLIFE SANCTUARY.



coloured butterflies like Blue Marmon will be protected. This protected zone would thus rehabilitate a number of plant and animal species that are fast disappearing from the Western Ghats.

The villagers who prefer to stay on in their native villages will have to be provided work in the replantation programme. As shifting cultivation and charcoal making is to be discontinued the wage earnings must be sufficient to meet their basic needs. The table lands on the middle slopes are the only places in this zone that are suited for commercial plantation programme. Trees like Anthocephalus cadamba, Mecaranga peltata, Syzygium cumini, Alstonia scholaris and Actinodaphne angustifolia are suited for generating some income. The rest of the lands, the lands belonging to the forest department as well as the presently cultivated lands are to be treated as protected lands. To help reforestation of denuded areas a programme of plantation along the contours and stream banks should be taken up. Other activities like nature-based tourism such as bird-watching, study of sacred groves and botanical explorations would provide some seasonal employment to the inhabitants. The inhabitants can get some income from bee-keeping and fruit collection from wild plants like Carissa congesta, Meynea laxiflora and Shikekai. For back-yard gardens Dendrocalamus strictus, Mangifera indica, Artocarpus heterophyllus are well suited.

There are 238 bullocks, 422 cows and 103 she-buffaloes in this region. Once the practice of shifting cultivation is discontinued the need for cattle will be limited only to milk production for home consumption. Because of the inaccessibility of the region, milk export is not possible. The no. of cattle heads could thus be kept small. Grazing will have to be strictly controlled to help regeneration of the natural vegetation.

An attempt has been made in the above to indicate the development possibilities on the basis of a broad study of the terrain and vegetation of the selected villages from the four zones. A detailed plan can be prepared only on the basis of the basic geo-physical and botanical mapping. Experimentation will have to be carried out on a sustained basis to know the survival rates, growth rates and productivity of the various indigenous plants. These studies would prevent unscientific introduction of the exotics and provide firm directions for the maintenance of the ecology of the region. The final choice of the species to be planted at particular locations will have to be decided considering the soil depth, soil type, slope, rainfall and wind direction at the micro-level. As regards the implementation of the plan the approach is spelled out in the following chapter for the region as a whole. So also the other aspects, viz., improving accessibility, basic infrastructural facilities etc., are discussed in Chapter VI.

CHAPTER VI

Planning for Eco-development of Panshet Catchment

The study of economic and ecological impact of the construction of the Tanaji Sagar reservoir and the consequent deforestation has clearly brought out the urgent need to protect the catchment area through systematic reforestation. This can be achieved only if (a) shifting cultivation is discontinued, (b) uncontrolled grazing is checked, (c) charcoal making is prohibited. The peasants are aware of the problems arising due to the present pattern of economic activities. However there is no alternative. The redevelopment plan will therefore have to be formulated in view of the basic needs of the inhabitants of the region and the natural endowments of the region: The main characteristics of the region are (a) culturable lands are very limited, (b) soils are not very fertile. The land, except for the small patches on the lower reaches is inherently unsuited to sustained agriculture. Because of the high gradient and heavy rainfall the whole area becomes erosionally active. Active erosional processes lead to coarse texture of the soil. (c) The physiographic character of the area is well suited for the development of forest. Heavy rainfall is favourable for the growth of trees. Sacred grove near Mangaon which represents relic vegetation of the area gives an indication that if proper protection is ensured a good quality semi-evergreen forest can grow well in Zones III and IV.

The planning for the region will have thus to aim at (a) conservation of the existing biomass resources, (b) systematic utilization of the existing resources for improving the level of living of the peasants and Gavli Dhangars inhabiting the catchment area, (c) development of the flora and fauna of the region putting to maximum advantage the favourable geo-climatic factors.

The principal resource of the region viz., the forest and forest products had been a great asset to the peasants. This resource, at present, meets only a part of the needs viz., fuel, housing, fodder, timber, fruit and the sale of forest products viz., timber, fuelwood, charcoal, bamboo, gum, honey, hirda, fruit (Zizyphus rugosa, Carissa congesta, Meynea laxiflora) provides about 40 per cent of the cash income. However the resource base is getting depleted in the process. Hence an alternative strategy has to be devised to satisfy both the aims of conservation and development of the natural resource base and improving the levels of living of the inhabitants of this tract. This can be achieved only through a systematic reforestation plan.

1. Reforestation Plan:

The reforestation plan will involve (a) complete protection of the area from shifting cultivation, indiscriminate felling of trees and uncontrolled grazing thus making room for natural regeneration, (b) for areas particularly in Zone I and II

that are totally denuded, systematic planting in selected patches and broadcasting or sowing of seed would be necessary, (c) systematic planting along the lake bank, road side, nala banks will have to be undertaken. (d) Improvement of sacred groves and the forested areas will have to be effected.

Selection of Plants for Reforestation: While selecting tree species it is important to take into consideration factors like the possible economic uses, the adaptability of individual species in its natural surroundings and relation with other plant species. Higher weightage must be given to environmental suitability as against the rate of growth. Exotic species should be introduced only selectively, emphasis being given to the native species. Nitrogen fixing species should be preferred as the soils in the region are poor.

Plant species - trees and shrubs suited to the four zones, each zone divided into two classes considering the slope (above 20° and below 20°) are indicated in Table 6.1, the silvicultural characteristics of these species are presented in Table 6.2 and their economic uses are indicated in Table 6.3.

The proposals for Eco-development of the Panshet catchment area are presented schematically in Map 19. The plants suited for planting along the river bank, along lower, middle and upper contours in each of the four zones are indicated in the plan. The redevelopment plan will have to be

Tab 6:1 Suitable plant species for different zones of the Panshet Catchment Area

Local name	Plant name	Above 20° slope			Less than 20° slope			Reservoir bank
		I Zone	II Zone	III Zone	I Zone	II Zone	III Zone	
Babhul	<u>Acacia nilotica</u> Det	-	-	-	+	-	-	+
Shikekai	<u>Acacia rugata</u>	-	-	-	-	-	-	-
Pisadi	<u>Actinodaphne angustifolia</u> Nees	-	+	+	-	-	+	-
Hedu	<u>Adina cordifolia</u> Benth	-	-	+	-	+	+	-
Shirish	<u>Albizia lebbek</u> Benth	-	-	-	-	-	-	-
Satvin	<u>Alistonia scholaris</u> R.Br.	-	-	+	-	-	+	+
Kaju	<u>Anacardium occidentale</u> L	-	-	-	+	+	-	-
Dhavda	<u>Anogeissus latifolia</u> Wall	-	+	+	-	+	+	-
Kadam	<u>Anthocephalus cadamba</u> Miq	-	+	+	-	+	+	-
Phanas	<u>Artocarpus heterophyllus</u>	-	-	-	+	+	+	-
Nim	<u>Azadirachta indica</u> A.Juss	-	-	-	+	+	-	+
Apta	<u>Bauhinia racemosa</u> Lam	+	+	-	+	+	-	-
Moha	<u>Bassia latifolia</u> Roxb	-	-	+	-	+	+	+
Savar	<u>Bombax ceiba</u> L	-	-	-	+	+	-	+
Asna	<u>Bridelia squamosa</u> Skeels	+	+	-	+	+	-	-
Char	<u>Buchanania lanzan</u> Spreng	+	+	-	-	+	-	-
Palas	<u>Butea monosperma</u> Taub	+	+	+	-	-	+	-

+ indicates suitability of plant

Local name	Plant name	Above 20° slope			Less than 20° slope			Reservoir bank
		I Zone	II Zone	III Zone	I Zone	II Zone	III Zone	
Khutkes	<u>Cassine glauca</u> O.Ktze.	+	-	-	+	+	-	-
Kumbha	<u>Careya arborea</u> Roxb.	+	-	-	+	+	-	+
Bherli-mad	<u>Caryota urens</u> L.	-	-	-	-	+	+	-
Bokhra	<u>Casearia graveolens</u> Delz	-	+	+	-	-	+	-
Bava	<u>Cassia fistula</u> L.	+	+	-	+	+	-	-
Suru	<u>Casuarina equisetifolia</u> Forst.	-	-	-	+	-	-	-
Bhokar	<u>Cordia dichotoma</u>	-	-	-	+	+	+	-
Sisvi	<u>Dalbergia sissoo</u> Roxb.	+	-	-	+	+	-	-
Sissum	<u>Dalbergia latifolia</u> Roxb.	+	+	-	+	+	-	-
Basa	<u>Dendrocalamus strictus</u> Nees.	+	-	-	+	+	+	+
Karmal	<u>Dillenia pentagyna</u> Roxb.	-	-	+	-	+	+	-
Yerindi	<u>Dysoxylum binectariferum</u> Hook&P.	-	-	-	-	-	-	-
Avla	<u>Emblica officinalis</u> Gaertn.	-	-	-	-	-	+	-
Pangara	<u>Erythrina variegata</u> L.	+	+	-	+	-	-	-
Nivdung	<u>Euphorbia nivula</u> Buch.	+	+	+	-	-	-	-
Pair	<u>Ficus arnottiana</u> Miq.	-	+	+	-	-	-	-

Local name	Plant name	Above 20° slope			Less than 20° slope			Reservoir bank
		I Zone	II Zone	III Zone	I Zone	II Zone	III Zone	
Umbar	<u>Ficus glomerata</u> Roxb.	-	+	-	+	+	-	-
Nandruk	<u>Ficus retusa</u> L.	-	+	-	+	+	-	-
Tambat	<u>Flacourtia latifolia</u> T.Cooke.	-	+	-	-	+	-	-
Tambat	<u>Flacourtia sepaiaria</u> Roxb.	+	+	-	-	-	-	-
Kokum	<u>garcinia indica</u> Choiss	-	-	-	-	+	-	-
-	<u>Gliricidia sepium</u> Skud	-	-	-	+	-	-	-
Shivan	<u>Gmelina arborea</u> Roxb.	+	-	-	+	+	-	+
Dhaman	<u>Grewia tiliaefolia</u> Vahl.	+	+	-	+	+	-	-
Anjani	<u>Hardwickia binata</u> Roxb.	+	+	-	-	-	-	-
Varas	<u>Heterophragma quadriloculare</u> K.Schum	-	-	+	-	+	+	+
Serni	<u>Homonoia riparia</u> Lour.	-	-	-	-	-	-	+
Nana	<u>Lagerstroemia lanceolata</u> Wall.	-	-	-	-	+	+	-
Su-babul	<u>Leucaena leucocephala</u>	-	-	-	+	-	-	-
Chandada	<u>Macaranga tomentosa</u> Wight.	-	-	-	-	-	+	-
Shendri	<u>Mallotus philippinensis</u> Muell.	-	+	+	-	+	+	-
Amba	<u>Mangifera indica</u> L.	-	-	-	+	+	+	+
Limbara	<u>Melia composita</u> Willd.	-	-	-	+	+	+	+

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Local name	Plant name	Above 20° slope			Less than 20° slope			Reservoir bank
		I Zone	II Zone	III Zone	i Zone	II Zone	III Zone	
Anjani	<u>Memecylon umbellatum</u> Burm.	-	-	+	-	-	+	-
Tuti	<u>Morus alba</u> L.	-	-	-	-	-	-	+
Kadhi-nimb	<u>Murraya koenigii</u> Spr.	-	-	+	-	+	+	-
Par-jamb	<u>Olea dioica</u> Roxb.	-	-	+	-	-	+	+
Choua	<u>Oxytenanthera monostigma</u> Bedd.	-	-	-	-	-	-	+
Shindi	<u>Phoenix sylvestris</u> Roxb.	-	-	-	-	-	-	+
Karanj	<u>Pongamia pinnata</u> Piers.	-	-	-	+	-	-	+
-	<u>Salix babylonica</u> L.	-	-	-	-	-	-	+
Walunj	<u>Salix tetrasperma</u> Roxb.	-	-	-	-	-	-	+
Jangli badam	<u>Sterculia foetida</u> L.	-	-	-	-	-	+	+
Golder	<u>Sterculia guttata</u> Roxb.	-	-	-	-	-	+	-
Jambul	<u>Syzygium cumini</u> Skeels.	-	+	+	-	-	+	+
Ain	<u>Terminalia alata</u> Heyne.	+	+	-	+	+	-	-
Behda	<u>Terminalia bellerica</u> Roxb.	-	+	+	-	+	+	-
Hirda	<u>Terminalia chebula</u> Rätz.	-	+	+	-	+	+	-

Local name	Plant name	Above 20° slope			Less than 20° slope			Reservoir bank
		I Zone	II Zone	III Zone	I Zone	II Zone	III Zone	
Gela	<u>Xeromphis spinosa</u> Keay.	-	+	+	-	-	-	-
Yerul	<u>Xylia dolabriformis</u> Benth	+	-	+	-	+	+	-
Bor	<u>Zizyphus mauritiana</u> Lamk.	+	+	-	-	-	-	-
Shrubs & small trees								
Adulsa	<u>Adhatoda vasica</u> Nees.	-	-	-	-	+	+	-
Chillara	<u>Caesalpenia seniaria</u> Roxb	+	+	+	-	-	-	-
Karvand	<u>Carissa congesta</u> Wigesto.	+	+	+	+	+	+	+
Karvi	<u>Carvia callosa</u> Bremek.	-	+	+	-	-	-	-
Kuda	<u>Holarrhena antidysenterica</u> Wall.	-	-	+	-	-	+	-
Rametha	<u>Lasiosiphon eiocephalus</u> Dene.	+	+	+	-	-	-	-
Aloo	<u>Meynea laxiflora</u> Robyns.	+	+	+	+	+	+	-
Nirgudi	<u>Vitex negundo</u> L.	-	-	-	+	-	-	+
Bhauri	<u>Woodfordia fruticosa</u> Kurz.	+	+	+	+	+	+	-
Kala-kuda	<u>Wrightia tinctoria</u> R.Br.	-	-	+	-	-	+	-
Turan	<u>Zizyphus rugosa</u> Lam.	+	+	+	+	+	+	-

Tab. 62 Silvicultural characteristics of plant species suitable for regeneration in the Panshet Catchment Area

Plant name	Tt	Mt	S	Th	Dh	Mdh	Ds	Sd	Ld	Fh	Mth	Ft	Tlf
<u>Acacia nilotica</u> Det	-	+	-	+	+	+	-	+	+	-	-	+	+
<u>Acacia rugata</u>	-	-	-	+	-	+	-	-	+	-	+	-	+
<u>Actinodaphne angustifolia</u> Nees	-	+	-	-	-	-	-	-	-	-	-	-	+
<u>Adina cordifolia</u> Benth	+	-	-	-	-	+	-	-	+	-	+	-	+
<u>Albizzia lebbek</u> Benth.	+	-	-	-	-	-	+	+	-	-	-	-	+
<u>Alstonia scholaris</u> R.Br.	+	-	-	-	-	-	+	+	-	-	-	-	-
<u>Anacardium occidentale</u> L	-	+	-	-	-	+	-	-	+	-	-	-	-
<u>Anogeissus latifolia</u> Wall	-	+	-	-	-	-	+	-	-	-	+	-	+
<u>Anthocephalus cadamba</u> Lig	-	+	-	-	-	+	-	-	+	-	-	-	+
<u>Artocarpus heterorhynchus</u>	+	-	-	-	-	+	-	-	+	-	-	-	-
<u>Azadirachta indica</u> A.Juss	+	-	-	-	-	+	-	-	+	-	-	+	-
<u>Bauhinia racemosa</u> Lam.	-	+	-	-	-	+	-	-	+	-	-	+	+
<u>Bassia latifolia</u> Roxb	+	-	-	-	-	-	+	+	-	+	-	-	-
<u>Bombax ceiba</u> L	+	-	-	+	-	+	-	-	+	-	+	-	+
<u>Bridelia squarrosa</u> Kceels	+	-	-	+	+	-	-	-	+	-	+	-	+
<u>Buchanania lanzan</u> Spreng	-	+	-	-	-	+	-	-	+	-	+	-	+
<u>Butea monosperma</u> Taub	+	-	-	-	-	+	-	-	+	-	+	-	+

Plant name	Tl	Ml	S	Th	Dh	Mdh	Ds	Sd	Ld	Fh	Mfh	Ft	Tlf
<u>Cassine glauca</u> O.Ktze.	-	+	-	-	-	+	-	-	+	-	+	-	-
<u>Careya arborea</u> Roxb.	-	+	-	-	-	+	-	+	+	-	+	-	-
<u>Caryota urens</u> L.	+	-	-	-	-	-	+	+	-	-	+	-	-
<u>Casearia graveolens</u> Delz	-	+	-	-	-	+	-	+	-	-	+	-	-
<u>Cassia fistula</u> L.	-	+	-	-	-	+	+	-	-	-	+	-	-
<u>Catuarina equisetifolia</u> Forst.	+	-	-	-	-	+	-	-	+	-	+	-	-
<u>Cordia dichotoma</u> Forst.	-	+	-	-	-	+	+	-	+	-	-	-	-
<u>Dalbergia sissoo</u> Roxb.	+	-	-	-	-	+	-	-	-	+	-	-	+
<u>Dalbergia latifolia</u> Roxb.	+	-	-	-	-	+	-	-	-	-	+	-	+
<u>Dendrocalamus strictus</u> Vees.	+	-	-	-	-	+	-	-	-	-	-	-	+
<u>Dillenia pentagyna</u> Roxb.	-	+	-	-	-	-	+	-	+	-	-	+	+
<u>Dysoxylum binectariferum</u> Hook&F.	+	-	-	-	-	-	+	+	-	-	-	-	-
<u>Embllica officinalis</u> Gaertn.	-	+	-	-	+	-	-	-	+	+	-	-	+
<u>Erythrina variegata</u> L.	+	-	-	+	+	-	-	-	+	+	-	-	+
<u>Euphorbia nivula</u> Buch.	-	+	-	-	+	-	-	-	+	+	-	-	-
<u>Ficus arnot'iana</u> Miq.	+	-	-	-	+	-	-	-	+	+	-	-	-

Plant name	Tt	Mt	S	Th	Dh	Mdh	Ds	Sd	Ld	Fh	Mfh	Ft	Tlt
<u>Ficus glomerata</u> Roxb.	+	-	-	-	+	-	-	-	+	-	-	-	+
<u>Ficus retusa</u> L.	+	-	-	-	+	-	-	-	+	-	-	-	+
<u>Flacourtia latifolia</u> T.Cooke.	-	+	-	+	+	-	-	-	+	-	-	-	-
<u>Flacourtia sepaiaria</u> Roxb.	-	+	-	+	+	-	-	-	+	-	-	-	-
<u>Garcinia indica</u> Choiss	+	-	-	-	-	+	-	-	+	-	-	-	-
<u>Gliricidia sepium</u> Skud	-	+	-	-	-	+	-	-	+	-	+	-	-
<u>Gmelina arborea</u> Roxb.	+	-	-	-	-	+	-	+	-	-	+	-	+
<u>Grewia tiliaefolia</u> Vahl.	-	+	-	-	-	+	-	+	-	-	-	-	+
<u>Hardwickia binata</u> Roxb.	-	+	-	-	+	-	-	-	+	-	+	-	+
<u>Heterophragma quadriloculare</u> K.Schum	+	-	-	-	-	-	+	+	-	-	-	-	+
<u>Homonoia riparia</u> Lour.	-	-	+	-	-	-	-	-	-	-	-	-	-
<u>Lagerstroemia lanceolata</u> Wall.	+	-	-	-	+	-	-	+	+	+	-	-	-
<u>Leucaena leucocephala</u>	+	-	-	-	-	+	-	-	-	+	-	-	+
<u>Lacaranga tomentosa</u> Wight.	-	+	-	-	-	+	-	-	+	-	-	-	-
<u>Mallotus philippinensis</u> Muell.	-	+	-	-	+	-	-	+	-	-	-	-	-
<u>Mangifera indica</u> L.	+	-	-	-	-	-	+	+	-	-	-	-	-
<u>Melia composita</u> Willd.	+	-	-	-	-	+	-	-	-	-	+	-	-

Plant name	Tt	Mt	S	Th	Dh	Mdh	Ds	Sd	Ld	Fh	Mfh	Ft	Tlf
<u>Memecylon umbellatum</u> Burm.	-	+	-	-	+	-	-	-	+	-	-	-	-
<u>Morus alba</u> L.	-	+	-	-	-	+	-	-	+	-	+	-	+
<u>Murraya koenigii</u> Spr.	-	+	-	-	-	-	+	+	-	-	-	-	-
<u>Olea dioica</u> Roxb.	-	+	-	-	-	-	+	+	-	-	-	-	-
<u>Oxytenanthera monostigma</u> Bedd.	+	-	-	-	-	+	-	+	-	-	-	-	+
<u>Phoenix sylvestris</u> Roxb.	-	+	-	-	-	-	+	-	+	-	-	-	-
<u>Longania pinnata</u> Piers.	-	+	-	-	-	-	+	-	+	-	+	-	-
<u>Salix babylonica</u> L.	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Salix tetrasperma</u> Roxb.	-	-	-	-	-	-	-	-	+	-	-	-	-
<u>Sterculia foetida</u> L.	+	-	-	-	-	+	-	+	-	-	-	-	-
<u>Sterculia guttata</u> Roxb.	+	-	-	-	-	+	-	-	-	-	-	-	-
<u>Syzygium cumini</u> Skeels.	+	-	-	-	-	+	-	+	-	-	-	-	-
<u>Terminalia blata</u> Heyne.	+	-	-	-	+	-	-	-	+	-	-	+	+
<u>Terminalia bellerica</u> Roxb.	+	-	-	-	+	-	-	-	+	-	-	+	+
<u>Terminalia chebula</u> Retz.	+	-	-	-	+	-	-	-	+	-	-	+	+

Plant name	Tl	Ml	S	Th	Dh	Mdh	Ds	Sd	Ld	Fh	Mfh	Ft	Tlf
<u>Xeromphis spinosa</u> Keay.	-	-	+	-	+	-	-	-	+	-	-	-	-
<u>Xylia dolabriformis</u> Benth	+	-	-	-	-	-	+	+	-	-	-	-	-
<u>Zizyphus mauritiana</u> Lamk.	-	+	-	-	+	-	-	-	+	+	-	-	-
Shrubs & small trees													
<u>Adhatoda vasica</u> Nees.	-	-	+	-	-	-	+	+	-	-	-	-	-
<u>Caesalpinia sepiaria</u> Roxb	-	-	+	+	-	-	-	-	+	-	-	-	-
<u>Carissa congesta</u> Wigesto.	-	-	+	+	+	-	-	-	+	-	-	-	-
<u>Carvia callosa</u> Bremek.	-	-	+	-	-	-	+	-	+	-	-	-	-
<u>Holarrhena antidysenterica</u> Wall.	-	-	+	-	+	-	-	-	+	-	-	-	-
<u>Lasiosiphon eriocephalus</u> Dene.	-	-	+	-	-	+	-	-	+	-	-	-	-
<u>Meynea laxiflora</u> Robyns.	-	-	+	+	+	-	-	-	+	-	-	-	-
<u>Vitex negundo</u> L.	-	-	+	-	-	-	+	-	+	-	-	-	-
<u>Woodfordia fruticosa</u> Kurz.	-	-	+	-	-	+	-	-	+	-	-	-	-
<u>Wrightia tinctoria</u> R.Br.	-	-	+	-	+	-	-	-	+	-	-	-	-
<u>Zizyphus rugosa</u> Lam.	-	-	+	+	+	-	-	-	+	-	-	-	-

Abbreviations Used in Table 6.2

Tt	:	Tall tree (more than 60 ft)
Mt	:	Moderate sized tree (20 to 60 ft)
S	:	Shrub
Th	:	Thorny
Dh	:	Drought hardy
Mdh	:	Moderately drought hardy
Ds	:	Drought sensitive
Sd	:	Shade demander
Ld	:	Light demander
Fh	:	Frost hardy
Mfh	:	Moderately frost hardy
Ft	:	Frost tender
Tlf	:	Tree leaf fodder
Blank:		Not known

Tab 6-3 Economic uses of plant species suitable for regeneration in the Panshet Catchment Area

Plant name	T	F	C	Ag	Ho	Bo	To	Ot	Dy	Ed	Me	N ₂
<u>Acacia nilotica</u> Det.	+	+	-	+	+	-	-	+	B,P	-	G	+
<u>Acacia rugata</u>	-	-	-	-	-	-	-	-	-	-	-	+
<u>Actinodaphne angustifolia</u> Nees.	+	-	-	-	+	-	-	+	-	-	-	-
<u>Adina cordifolia</u> Benth.	+	+	+	+	+	+	-	-	-	-	-	-
<u>Albizia lebbek</u> Benth	-	-	-	-	-	-	-	-	-	-	-	-
<u>Alstonia scholaris</u> R.Br.	+	-	+	+	+	-	-	+	-	-	R	-
<u>Anacardium occidentale</u> L.	-	-	-	-	-	+	-	O,G,R	B	F		-
<u>Anogeissus latifolia</u> Wall.	+	-	-	+	+	-	-	G	L,B	-	-	-
<u>Anthocephalus cadamba</u> Miq.	-	-	-	-	-	-	-	-	-	F	-	-
<u>Artocarpus heterophyllus</u> .	-	-	-	-	-	-	-	G,R	W	F	-	-
<u>Azadirachta indica</u> A.Juss.	+	+	-	+	+	+	-	O	-	F	S,L	-
<u>Bauhinia racemosa</u> Lam.	+	+	-	+	-	-	-	G	-	-	G	+
<u>Bassia latifolia</u> Roxb.	+	-	+	-	-	-	-	O	B,L	F	O	-
<u>Bombax ceiba</u> L.	+	+	-	-	-	-	-	Fi	-	-	-	-
<u>Bridelia squamosa</u> Skeels.	+	+	-	+	+	+	-		B	F	-	-
<u>Buchanania lanzan</u> Spreng.	-	-	-	-	-	-	-	O,G	B	F	-	-
<u>Eutea monosperma</u> Taub.	+	-	+	+	+	-	+	G	Fl	-	G	+

Plant name	T	F	C	Ag	Ho	Bo	To	Ot	DY	Ed	Me	N ₂
<u>Ficus glomerata</u> Roxb.	+	-	+	+	-	-	-	J	B	F	RBLF	-
<u>Ficus retusa</u> L.	+	-	+	+	-	-	-	-	-	-	-	-
<u>Flacourtia latifolia</u> T.Cooke.	-	+	-	-	-	-	-	-	-	F	-	-
<u>Flacourtia sepaiaria</u> Roxb.	-	-	-	-	-	-	-	-	-	F	-	-
<u>Garcinia indica</u> Choiss	+	-	-	-	-	-	-	O	J	F	FBS	-
<u>Gliricidia sepium</u> Skud	-	+	-	-	-	-	-	-	-	-	RLRF	+
<u>Gmelina arborea</u> Roxb.	+	-	-	+	+	-	-	-	-	F	RLRF	+
<u>Grewia tiliacifolia</u> Vahl.	+	-	-	+	+	-	-	Fi	-	F	-	-
<u>Hardwickia binata</u> Roxb.	+	+	-	+	+	-	-	Fi	-	-	-	+
<u>Heterophragma quadriloculare</u> K.Schum	+	-	+	-	-	-	-	-	-	-	-	-
<u>Homonola riparia</u> Lour.	-	+	-	-	+	+	-	-	-	-	-	-
<u>Lagerstroemia lanceolata</u> Wall.	+	-	+	+	+	+	-	-	-	-	-	-
<u>Leucaena leucocephala</u>	+	+	-	+	+	-	-	Fi	-	F	-	-
<u>Macaranga tomentosa</u> Wight.	-	-	-	-	-	-	-	G	-	F	-	-
<u>Mallotus philippinensis</u> Muell.	-	+	-	-	-	-	-	O	F,B	-	O	-
<u>Mangifera indica</u> L.	+	+	-	+	+	-	-	G	BL	F	RLRF	-
<u>Melia composita</u> Willd.	+	-	-	+	+	+	-	-	-	-	-	-

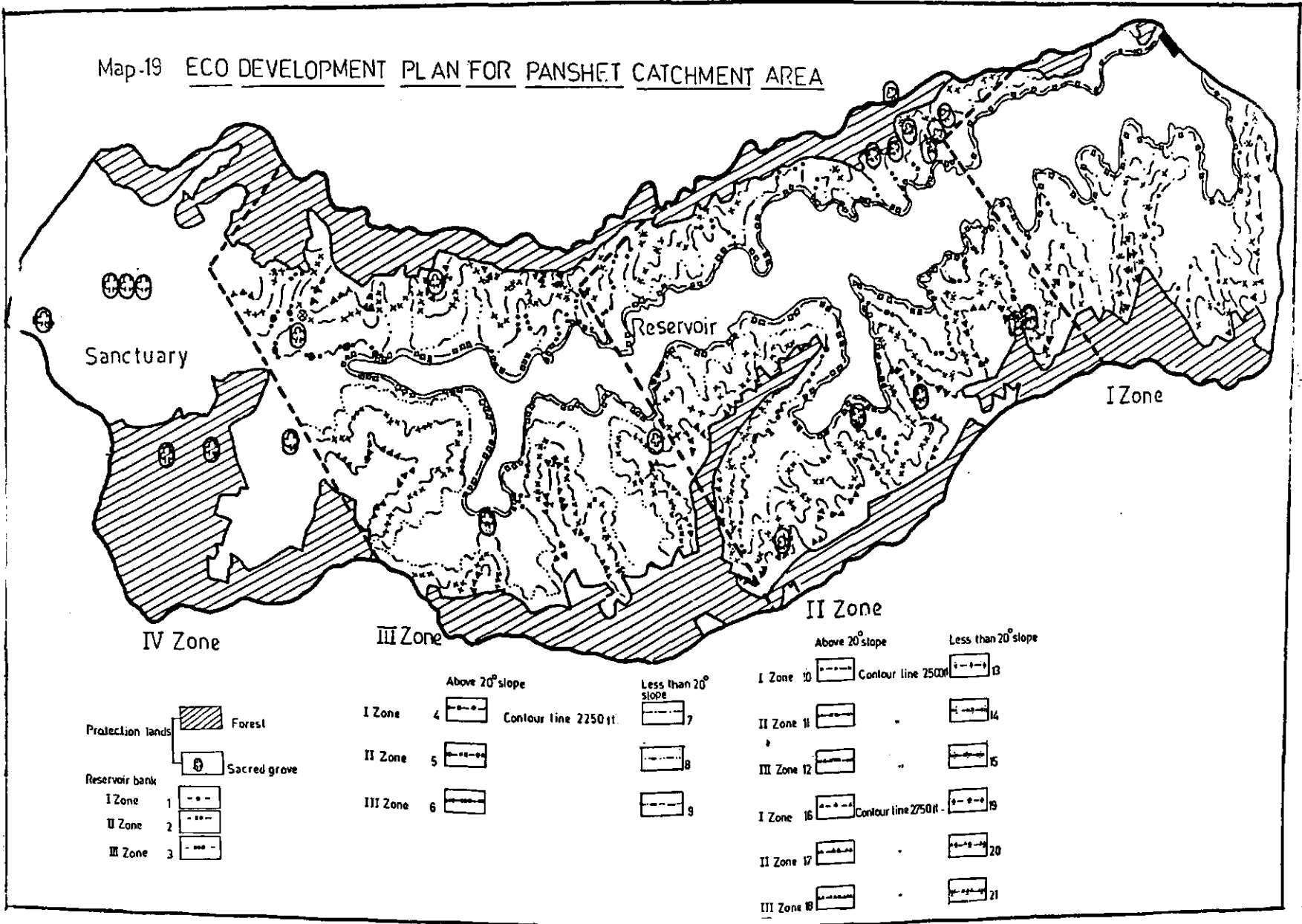
Plant name	T	F	C	Ag	Ho	Bo	To	Ot	Dy	Ed	Me	N ₂
<u>Mimocydon umbellatum</u> Burm.	+	-	+	+	-	-	-	-	L	F	-	-
<u>Morus alba</u> L.	-	-	-	-	-	-	-	Fi	-	F	-	-
<u>Murraya koenigii</u> Spr.	-	-	-	-	-	-	-	LO	-	-	-	-
<u>Olea dioica</u> Roxb.	+	-	-	+	+	-	-	-	-	F	-	-
<u>Oxytenanthera monostigma</u> Bedd.	+	-	-	-	+	-	-	-	-	-	-	-
<u>Phoenix sylvestris</u> Roxb.	-	-	-	-	-	-	-	L	-	F	R,F,J	-
<u>Pongamia pinnata</u> Fiers.	+	-	-	+	-	-	-	Fi,O	-	-	QR,BL	-
<u>Salix babylonica</u> L.	+	-	-	-	-	-	-	-	-	-	-	-
<u>Salix tetrasperma</u> Roxb.	+	-	-	-	-	-	-	-	-	-	-	-
<u>Sterculia foetida</u> L.	-	+	-	-	-	-	-	G,Fi	-	-	S	-
<u>Sterculia guttata</u> Roxb.	+	-	-	+	-	-	-	Fi	-	-	-	-
<u>Syzygium cumini</u> Skeels.	+	-	-	+	+	-	-	-	L	F	F,B,S	-
<u>Terminalia alata</u> Heyne.	+	+	-	+	+	+	-	G	B	-	-	-
<u>Terminalia bellerica</u> Roxb.	+	-	+	+	+	+	-	OG	F	-	F,B,S	-
<u>Terminalia chebula</u> Retz.	+	-	+	+	+	+	-	-	F	-	B,F	-

Plant name	T	F	C	Ag	Ho	Bo	To	Ot	Dy	Ed	Me	N ₂
<u>Xeromphis spinosa</u> Keay.	+	+	-	-	-	-	-	F	-	F	-	-
<u>Xylia dolabriformis</u> Benth.	+	-	-	+	+	-	-	R	-	-	-	-
<u>Zizyphus mauritiana</u> Lamk.	-	-	-	-	-	-	-	-	BLF	F	-	-
Shrubs & small trees												
<u>Adhatoda vasica</u> Nees.	-	+	-	-	-	-	-	-	-	-	-	-
<u>Caesalpenia sepiaria</u> Roxb	-	+	-	-	-	-	-	O	B	-	-	-
<u>Carissa congesta</u> Wigesto.	-	-	-	-	-	-	-	-	-	Fr	-	-
<u>Carvia callosa</u> Bremek.	-	+	-	-	-	-	-	-	-	-	-	-
<u>Holarrhena antiysenterica</u> Wall.	+	+	-	+	-	-	+	O	-	-	BLFS	-
<u>Lasiosiphon eriocephalus</u> Dene.	-	+	-	-	-	-	-	Fi	-	-	L,B	-
<u>Meynea laxiflora</u> Robyns.	-	+	-	-	-	-	-	-	-	Fr	-	-
<u>Vitex negundo</u> L.	-	+	-	-	-	-	-	-	-	-	L,R	-
<u>Woodfordia fruticosa</u> Kurz.	-	+	-	-	-	-	-	-	Fl	-	B,F-	-
<u>Wrightia tinctoria</u> R.Br.	+	+	-	+	-	-	-	-	Fl,B	-	B,S	-
<u>Zizyphus rugosa</u> Lam.	-	+	-	-	-	-	-	-	-	Fr	R,B,L,F	-

Abbreviations Used in Table 6.3

T	:	Timber
F	:	Fuel
C	:	Charcoal
Ag	:	Wood is used for agricultural implements
Ho	:	Wood is used for housing purposes
Bo	:	Wood is used for boat making
To	:	Wood is used for Toys
Ot	:	Other purposes O : Oil, G : Gums; R : Resins; J : Juice; L : Leaves; Fi : Fibre
Dy	:	Dye or tanning property of the plant L : Leaves; Fl : Flowers; B : Bark; P : Pods; F : Fruits
Ed	:	Edible part of the plant F : Fruit; S : Seed; Fl : Flower
Me	:	Part of the plant used in medicine Fl : Flower B : Bark R : Root G : Gum S : Seed Pl : Whole plant L : Leaves F : Fruits
N ₂	:	Nitrogen fixing ability

Map-19 ECO DEVELOPMENT PLAN FOR PANSHET CATCHMENT AREA



Sanctuary

Reservoir

I Zone

IV Zone

III Zone

II Zone

Above 20° slope

Less than 20° slope

Above 20° slope

Less than 20° slope

I Zone 4

Contour line 2250 ft.

7

I Zone 10

Contour line 2500 ft.

13

II Zone 5

8

II Zone 11

14

III Zone 6

9

III Zone 12

15

I Zone 16

Contour line 2750 ft.

19

II Zone 17

20

III Zone 18

21

Protection lands

Forest

Reservoir bank

I Zone

II Zone

III Zone

Sacred grove

Index to Map 19

Reservoir bank

- | | | | |
|----|--|----|---|
| 1 | <u>Salix</u> Sp
<u>Vitex negundo</u>
<u>Morus alba</u>
<u>Dendrocalamus strictus</u> | 2 | <u>Salix</u> Sp
<u>Vitex negundo</u>
<u>Morus alba</u>
<u>Dendrocalamus strictus</u> |
| 3 | <u>Salix</u> Sp
<u>Acacia rugata</u>
<u>Dendrocalamus strictus</u>
<u>Anthocephalus cadamba</u> | 4 | Production lands
<u>Butea monosperma</u> |
| 5 | <u>Terminalia alata</u>
<u>Bridelia squamosa</u> | 6 | <u>Alstonia scholaris</u>
<u>Lagerstroemia lanceolata</u> |
| 7 | <u>Dalbergia sissoo</u>
<u>Azadirachta indica</u>
<u>Leucaena leucocephala</u> | 8 | <u>Melia composita</u>
<u>Gmelina arborea</u> |
| 9 | <u>Cordia dichotoma</u>
<u>Dysoxylum binectariferum</u> | 10 | <u>Erythrina variegata</u> |
| 11 | <u>Butea monosperma</u>
<u>Erythrina variegata</u> | 12 | <u>Terminalia bellerica</u>
<u>Terminalia chebula</u> |
| 13 | <u>Terminalia alata</u>
<u>Bridelia squamosa</u> | 14 | <u>Anogeissus latifolia</u>
<u>Terminalia Sp</u> |
| 15 | <u>Dysoxylum binectariferum</u>
<u>Xylia dolabriformis</u> | 16 | <u>Erythrina variegata</u>
<u>Bauhinia racemosa</u> |
| 17 | <u>Ficus</u> Sp
<u>Emblica officinalis</u> | 18 | <u>Memecylon umbellatum</u>
<u>Ficus</u> Sp |
| 19 | <u>Dalbergia latifolia</u>
<u>Dalbergia sissoo</u> | 20 | <u>Actinodaphne angustifolia</u>
<u>Dillenia pentagyna</u> |
| 21 | <u>Syzygium cumini</u>
<u>Actinodaphne angustifolia</u> | | |

implemented in a phased manner, beginning with the establishment of the plant nurseries in all the villages and experimental stations in each of the four zones. Reforestation plan can be taken up when the nurseries are established. The priorities for plantation are road side, nala side, upper contours, reservoir bank, middle and lower contours. In addition economically valuable plants should be planted in the backyards and programme for grafting of mango trees should be taken up. Rest of the area can be rehabilitated through natural regeneration. This would be possible if protection from cattle grazing and tree-cutting is provided. The process of regeneration can be selectively accelerated through broadcasting seed in suitable areas.

In the eco-development plan, moist deciduous trees are mainly suggested for Zones I and II. Trees like Butea monosperma, Terminalia alata, Hardwickia binata, Grewia tiliaefolia, Cassia fistula, Bauhinia racemosa, Careya arborea, Embllica officinalis, Bombax ceiba, Erythrina variegata, Bridelia squamosa can withstand the long dry months and can be grown in the first and second zones. Plants like Hardwickia binata, Bauhinia racemosa, Butea monosperma, and Erythrina variegata fix nitrogen also. These trees occur up to an altitude of 1200 metres. Rainfall requirements range from 800 mm to 3500 mm under natural conditions. All these trees grow well in open terrain. Leaves are generally not browsed by the cattle.

Trees like Melia composita, Azadirachta indica, Dalbergia sissoo and Pongamia pinnata can be successfully grown on lower gentle slopes of the first and second zones. The places with silt accumulation on the lower slopes provide ideal conditions for these trees.

The third zone which experiences high rainfall exhibits a semi-evergreen type of vegetation. Some economically useful plants, which are otherwise threatened are preserved in the sacred groves. These include Bassia latifolia, Dysoxylum binectariferum, Xylia dolabriformis. These can be grown on the upper slopes in the mixed forests. Plants like Dillenia pentagyna, Actinodaphne angustifolia, Lagerstroemia lanceolata, Terminalia chebula, and Terminalia bellarica occur in the mixed and deciduous forests on the middle contour. Trees like Butea monosperma, Cassine glauca, Adina cordifolia, Heterophragma quadriloculare, Anthocephalus cadamba, Alstonia scholaris are suitable for the lower gentle slopes of the third zone.

Some trees like Syzygium cumini, Mangifera indica, Bauhinia racemosa, Dendrocalamus strictus can be grown in any of the three zones. These trees are adapted to a variety of climates.

The fourth zone which is at the crest of the Ghats exhibits a great diversity of plant and animal life. The animal life includes some threatened animals like Mouse deer.

Hence this zone should be free from any human interference and should be declared as a sanctuary.

Once the vegetal cover is established on the slopes grasses like Themeda quadrivolis and Heteropogon contortus will give a way to more palatable grass species like Arundinella and Isachne.

To help the reforestation of the catchment area certain soil conservation measures are necessary to conserve the soil, specially during the monsoon when the gushing rain water washes away the upper layer of soil. To check the velocity of torrential rains strip agro-forestry technique should be followed. The plants planted along the strips could be harvested with 10 to 15 years rotation so that there is always a sizable plant mass along the contour that would check the speed of torrents. Gentle slopes with sheet and rill erosion in the second and third zones should be protected by constructing diversion drains to divert runoff coming from the hillocks or unbunded area. Stone terracing should be provided along the rough contours of upper slopes. They will have to be provided with terrace outlets at proper intervals to let out the excess water. Drop-pits should be provided at intervals to check the velocity of water.

Encouraging vegetation growth along gully sides and beds, is the best and the safest way of stabilizing them.

Along the nala bank plants like Lasiosiphon eriocephalus, Zyzyphus rugosa, Emblica officinalis, Flacourtia latifolia should be planted.

The reservoir bank in the Ist, IInd and IIIrd zones should be covered with permanent vegetation which should not be allowed to cut. Strip plantation of Bamboo (Dendrocalmus strictus) together with other useful plants like Terminalia alata, Morus alba, Salix babylonica, Vitex negundo, Homonoia ripiraria, Acacia rugata along the reservoir bank will check the erosion -and siltation of reservoir.

Kaccha roads have been built from Panshet to Dapsare on the north bank and Panshet to Shirkoli on the south bank; this is resulting in gully formation and severe soil erosion. There is an urgent need of protecting the road sides. For this tree planting along both the sides of the road should be immediately taken up. Trees suited for road-side planting are Gliricidia maculata, Erythrina variegata, Bauhinia recemosa, Cassia fistula, Dalbergia sissoo, Gravelia robusta, Casuarina equestiformis. These are fast growing trees with short branches and are unpalatable to the cattle.

2. Control of Grazing:

Marked improvement can be achieved in the carrying capacity of grazing grounds by sub-dividing the area so as to check uncontrolled grazing over the entire area. By continuous

thin grazing the better grasses are grazed down while the inferior ones are left more or less untouched and allowed to seed. In this way inferior grasses spread. Under monsoon conditions the grass season is so short that rotation must be a rapid one if full advantage is to be taken of all growth before it has become old and lost its feeding value. Areas once grazed early in the season are not found to yield sufficient regrowth for harvesting as hay. If grazing could be restricted to the middle parts of the region and the upper slopes are protected and utilized for hay or silage better utilization of the resources could be achieved. No grazing should be permitted after January. The grass from the reserved area will have to be cut and preserved and the animals will have to be stall-fed till the plots are ready for grazing after the onset of monsoon i.e. till August. The peasants will have to be paid the regular daily wage rates for the grass-cutting work and permitted to use the grass for feeding their animals. It is equally important to plant trees supplying good quality fodder so that most of the feed requirements could be locally met. When improvements in the fodder resources are achieved and the basic infrastructural facilities are provided, plan for the introduction of improvement in the milch animals can be considered.

It is important that the Gavli Dhangars get involved in the redevelopment scheme from planning stage through implementation stage e.g. pasture conservation, fodder production,

proper rearing of the calves and feeding of the cattle. At the same time, arrangements for basic veterinary services and insurance cover for the animals will have to be made. Drinking water facilities will have to be provided both for the inhabitants and their livestock.

It is noted that the local breed of cows are poor in feed energy utilization whereas the local buffaloes are better converters of forage. If shifting cultivation is not practised, there will not be any need for bullocks. Shift to buffaloes should be possible once the fodder resources are improved. The price payable for milk must be worked out taking into account the costs involved so as to ensure proper feeding of the animals (including the calves who are today kept undernourished so as to sell larger quantity of milk). It is important that all these measures are taken simultaneously and not in an adhoc and isolated manner.

3. Natural Farming: Experimentation with no till cultivation on lands with slope less than 10° and a good soil cover would be worth trying. Today bullocks are needed for ploughing and threshing. Mechanisation of threshing would not pose a problem. However unless ploughing operation becomes redundant, substitution of bullock power by mechanical power is not feasible due to the nature of terrain. No till cultivation experimented with in Japan (Fukuoka, 1985) is based on the following

principles (a) there is no ploughing and turning of soil so as not to disturb the activities of micro-organism, earthworms. (b) The weed menace is checked by mulch of uncut straw; this enriches soil, checks growth of weed and bird menace. (c) A small quantity of chicken droppings to help decompose the straw is sufficient to maintain the fertility. The organic remains of the plants and the organic manure decomposed by bacteria and fungi and taken deep into the soil with the movement of the rainwater become food to micro-organisms and earthworms. Plant roots reach to lower strata of soil and draw the nutrients. (d) Rotation of crop is important to check the spread of diseases. The straw mulch used is not of the same crop but wheat straw is used in rice and rice straw in wheat cultivation

The hill slopes under tree plantation are used to grow vegetables, wherever suitable. The ground is kept covered to help improve the surface layer. Nitrogen fixing species are specially planted. The yields are noted to be comparable with the yields of chemical farming.

It would be useful to begin experimentation in natural farming in a village like Shirkoli where the Sahyadri Vikas Mandal is already experimenting with plantation programme.

4. Economic Returns:

Estimation of returns is very difficult since little information on the rate of survival of various trees, their

growth rate, annual yields is available for the study area. Crude estimates are attempted on the basis of information about the performance of the existing stock obtained through the field survey. For plants which are to be newly introduced in the area, like cashew no estimates are made, as there are many variables in relation to which no firm data are available. The expected returns from plantations like mulberry which are to form a basis for silk worm rearing programme are also difficult to specify, since it is uncertain, how far the silk worm rearing programme would get properly established.

Mango is expected to yield returns from the 7th year and the expected return (80 trees) is about Rs. 2,400 in the 7th year Rs. 2,700 in 8th year, Rs. 4,000 from 9th to 15th year and Rs. 4,500 from 16th year. Jackfruit bears fruit from about 10th year and a return of Rs. 2,500 (50 trees) is expected from 10th year. Other trees/shrubs growing wild also yield marketable fruit e.g., karvand, but the labour expenditure involved in collection of karvand is rather high. If karvand shrubs could be established in clusters or strips along contour, there will be a saving in the labour time. Bamboo gets ready for harvesting from the 7th year and can be harvested in 7th, 10th, 13th, 16th i.e. every third year. If rotation of three years is followed, the average expected return per hectare is Rs. 2,000 per year. Expected yield from the quick growing trees like Casurina in terms of fuelwood and poles (for 150 trees) is shown in Table 6.4.

Table 6.4: Expected Yield from Casurina

	Fodder		Poles	
	Quantity in kg.	Value in Rs.	No.	Value in Rs.
3rd year	300	60	-	-
5th year	3000	600	-	-
7th year	7500	1500	-	-
8th year	15000	4500	300	3000

Trees like hirda, neem, yield valuable fruit. For example, about 3000 kg. of fruit can be obtained from neem tree in the sixth year and 4,500 kg. from the 7th year (150 trees). The return at 20 ps. per kg. comes to Rs. 900 per hectare. In addition the leaves have insect repellent value but its potential is not yet fully explored. Loppings are useful as fuel and if the tree is lopped from the 3rd year, it leads to higher fruit yield. The tree can be felled in the 10th year and the value of poles would amount to Rs. 2250 ha. If full potential of its use is researched the neem tree can give higher return. In case of hirda, even though hirda fruit is of economic value, the return is uncertain due to price fluctuations. It is necessary to set a floor price and the Govt. should assure a minimum return in case the market price falls below the floor. The Government can buy hirda fruit and open up a centre for processing at Panshet to increase

the return on fruit sale to the local inhabitants. Other trees like char, behda, kokam yield valuable fruit. The regulation of prices is essential to provide a stable return. Apta leaves have a steady demand and collection of leaves can yield about Rs. 20 per day. In addition trees like shivan, limbara, jambhool, varas are useful as small timber; these can be harvested with short rotation (10 year). Bherli mad was abundant in the region and can be re-established. It yields madi which can be used fresh or for gur manufacture. The important fruits that grow in the region like mango, jackfruit, awla, jambhool, karvand can be used for making sat, mawa, chatani, pickles, jams, jellies, squashes etc., by setting up cottage industry units at Panshet township, Shirkoli, and Koshimghar. Grafting of mango trees will help improve the returns per tree.

There is a potential to grow medicinal plants like shatawari, sarpqandha, kuda, vavding, nirqudi and trees with high medicinal value like awla, hirda, behda. Some of the plants like erandi, ru, adulsa etc., are used by the local population for treating certain ailments (Table 6.5). Investigations into the medicinal value of these plants could indicate their potential future use.

There is thus a rich potential of using the biomass resources of the region for traditional uses as well as explore the possibility of new uses. However if the leaves, fruit, etc., are harvested, collected and transported raw out of

the region the return to the local population would be small. It is therefore important to experiment with the alternative end uses of the biomass resources as chemical intermediates (palms and tubers), structurals (bamboo, Dulbergia sissoo), food stuff processing industry, medicinal uses, use of dung and leaf litter for biogas generation etc. If part processing is completed in the region, it will help reduce the bulk and give better return to the local population. R & D efforts in these directions should form a part of the Western Ghat Development Programme. If a ten year programme is launched forthwith some results should be available by the time the trees mature and yield fruit.

Table 6.5: Medicinal Plants Used by the Villagers
in Panshet Catchment Area.

<u>Plant</u>	<u>To cure</u>
Adhatoda vasica - extract	Cough
Ricinus communis - leave juice	Jaundice
Terminalia chebula - bark	diarrhoea
Helicteres isora - pod	diarrhoea
Calotropis gigantea - sap	scabies
Semicarpus anacardium - nut levigated	wound
Ricinus communis - sap	wound
Artemisia abrotanum - extract	fever
Holarrhena antidysenterica - juice	snake-bite (cattle)
Dendropthe sp - bulb levigated	fracture (cattle)
Vitex negundo - leaf fomentation	contusion (cattle)
Viscum articulatum - bulb	eye injury (cattle)

Even if it is assumed that the biomass resources will be put only to traditional uses the possible economic benefits are expected to be higher than the returns obtained today from shifting cultivation and other activities. A broad estimate of the income after a ten year period is made at 1984 prices, and compared with the income noted in 1984. It is expected that the plantations will begin yielding fruit etc. by 1994. The average returns as indicated above are taken as the basis for the estimation. In case an estimation is not available, the returns are assumed to be of the order of low-income yielding tree like nim. The expected returns are worked out, assuming that the regeneration and plantation plan as suggested above will be implemented. Eventhough the average per hectare return from the reforested land is expected to be of the same order as the return obtained today from the shifting cultivation plot (the average return from the forested and plantation area is expected to be around Rs. 1500/ha) the area under plantation-forest will be larger than that under shifting cultivation. As noted above only about 11 per cent of the total area is under shifting cultivation in a particular year. The rest is fallow, almost devoid of any tree cover. With the progress in the redevelopment plan, it is expected that by the 10th year nearly 30 per cent the area will be under vegetation. In addition, the returns from milk production are expected to increase with the improvement in the fodder situation and provision of veterinary service. The estimated average family

income of the families in the Panshet catchment in 1984 was about Rs. 5300. The proposed plan should bring about an increase in their earnings by at least 40 per cent and place all the families above the poverty line.

Another advantage is the year-round availability of work in the forest-plantation area. There will be work in the nursery, plantation work, weeding, bamboo cutting, leave plucking, fruit harvesting, collecting honey and in addition there will be some employment in silk-worm rearing, fruit processing, primary processing of medicinal plants, basketry, rope-making etc. There is also a potential to increase the return to labour by organizing locally certain further stages of processing of say hirda, medicinal plants etc.

A new avenue of employment is the service industry. The region will have a vast potential for exploration and research when redeveloped. Particularly the IVth zone should be reserved as a sanctuary. It will have rich and diverse flora and fauna after a few years of full protection. It will then offer immense opportunities for nature observation and research. Schools and colleges should be involved to take advantage of this outdoor laboratory. Nature camping should be encouraged. The local population can be involved in the development and maintenance of the nature reserve. The village schools should be involved in the study of local flora and fauna. Sheltered coves and bays can harbour wild animals

if protection is afforded. Reeds and aquatic plants planted at the border of the bay will attract water birds. Fish farming can also be developed. Provision of food and services to the students, hikers etc., can provide some work opportunity to the local population. Care however must be taken to develop the place only for healthy recreation and for study and research and not for garnish tourism.

5. Plan Implementation:

The entire region should be treated as a conservation area. Purchase of or cutting of trees in the region for sale should be totally prohibited. The movement within the valley region can be easily checked as there is only one approach road originating from the dam site. Since bulk of the land in this region is under private ownership it is suggested that the government should take over the land on a long lease (say 20 years) from the owners and take up the responsibility for all the developmental work with the help of local labour; the local population will have to be responsible for the protection of the vegetation in the region. Villagewise nurseries will have to be developed to meet the large-scale needs of the reforestation programme. As the plants/trees mature the land owners should be allowed to take the produce from the reforested area. In the meantime they will have to be provided with alternative sources of income to compensate the loss because of the ban on shifting cultivation and tree-cutting. It is suggested that the

work of selective planting and eco-development of the region be taken up by the appropriate Departments of the State Government (Forest/Agriculture) under the Employment Guarantee Scheme (E.G.S.). It is estimated that it will be necessary to provide wage work to about 700 families residing in this zone. If the minimum income needed to meet the critical needs is set at Rs. 7,000/- per annum it will mean that wage work for 300 days at Rs. 12 per earner (assuming two earners per family) will have to be provided. This will involve an expenditure of about Rs. 50 lakh per year. The Government of Maharashtra spends about Rs. 120 crores per year under E.G.S. Allocation of about 50 to 100 lakhs for the Western Ghat talukas should not be difficult. The capital expenditure needed for land shaping, nala training, plantation etc., should be met through the funds made available by the Central Government under the Western Ghats Development Programme.

It is essential that the payment of wages under E.G.S. should be regular and assurance of wage employment for a period of say 10 years be given to the local population. The situation should be periodically reviewed to estimate the economic yield of various plants in the region and the decision regarding the wage-component should be taken on that basis. If the local population so desires they should be given part of the wages in kind (particularly millets). Continuous attempts for enriching the biotic composition of the vegetation and

introduction of secondary activities (e.g. bee keeping, sericulture, bamboo working, fruit preservation) on the basis of local produce will have to be made to progressively improve the economic situation of the people, without over-exploiting the resource base.

The region, if restored, on the line suggested above, will provide immense opportunities for nature observation, ecological research and experimentation. Considerable experimental work is needed to understand the population dynamics, growth rates, biomass production of the various plants in their natural environment. It is therefore essential to set up a few small agro-forestry experimental-cum-demonstration stations for exploratory studies and to familiarize the peasants with new techniques. The deforested lands owned by the forest department and the lands acquired by the irrigation department that are not submerged can be used for this purpose. Such lands may be leased to voluntary agencies for a specific period to develop the experimental-cum-demonstration centre. Such farms should be developed for experimentation in methods of propagation, fertilization and various treatments so as to conserve moisture in the dry season. (e.g. use of jalshakti - a chemical developed by the National Chemical Laboratory to be mixed with soil to enhance the moisture retaining capacity, use of an emulsion spray developed by Hico, to help conserve moisture in the plant or use of earthen pots for delivery of

water to the active root zone so as to save on waterings).

Experimentation with planting of seedlings of varying age viz., 6 months, 1 year and 2 years growth should also be taken up to evaluate the response to water stress and the rate of survival. The plants to be experimented with should be mainly the indigeneous species that provide fuelwood, forage, timber, fruit, bio-fertilizer or have medicinal value.

It is necessary to carry out research on the medicinal herbs in the region for further possible uses, study of other plants as potential chemical intermediates, biogas from digester using biomass, dry composting to meet the domestic needs, and producer gas for pumping water etc., in the national laboratories to help further development of the Western Ghats region.

6. Response of the Villagers:

The problem of redevelopment was discussed with the villagers. The villagers generally indicated a strong preference for continuation to stay in their native villages; at the same time they stressed the need for provision of work, preferably under the EGS and regeneration of vegetation. They expressed willingness to work on road works, digging pits, collection of forest produce, nursery and agro-forestry work. They suggested trees of economic value like mango, jackfruit, hirda, cashew, bamboo, jambhool, awla, teak, eucalyptus, shikekai, soobabhul for plantation and stressed the need for

protection from the cattle by providing a thorny fence. Since watering will not be possible the plants that can withstand water stress for 7-8 months have to be planted. Excepting a few villages like Shirkoli, Chikhali where the villagers expressed doubts about cooperative endeavour, the villagers generally felt that the work could be organized through Van Panchayat, i.e. formation of a village-level committee who should organize the work of plantation, after-care and protection of the trees. The villagers opined that the waste lands could be taken up for plantation. As regards the discontinuation of shifting cultivation, the response was obviously not favourable as this is the major source of their food supply. However it was suggested that the plots which are just left fallow could be taken up for revegetation and if the regrowth is satisfactory then they might find the alternative attractive. Unless they see the results, they would not be willing for a change-over. It is thus important for implementing the development plan to take two types of measures concurrently - (a) set up experimental stations to explore the appropriate mixes for replantation in the different zones, (b) begin continuous dialogue with the villagers and involve them in the replantation programme from the planning stage and develop a suitable organizational set-up.

7. Infrastructural Development:

As noted earlier, the Panshet Catchment area lacks most of the basic infrastructural facilities and since the village

settlements are very small in size it is uneconomic to provide the facilities like primary school, medical and veterinary services etc., for each village. From the point of view of protection of the hills it is not desirable to develop motorable roads along the ridges. Motor launch service also needs to be kept limited so as to protect the lake from oil pollution as the reservoir is a source of drinking water for Pune city. The launch service also does not reach the villages in the interior as the water level recedes. Provision of transport facilities is thus not easy and consequently it becomes difficult to extend other services. It is considered desirable to group the villages and develop basic facilities in the central village to serve the group. Dhindli, Kuravati and Panshet village can avail of the facilities at Panshet township. Kadve and Varghad are not very small and basic facilities can be provided in these villages. Ghodshet, Givashi and Shirkoli can form a group with Shirkoli as the central village and Koshimghar, Kambegi and Bhalawadi with Koshimghar serving as the central village. It is difficult to provide services in the IIIrd and IVth zone, particularly the IVth zone is almost inaccessible. So also it is difficult to provide facilities to the Dhangarwadis which are located away from the central villages. The alternative is to relocate these settlements. If alternative sources of employment are developed in Panshet-Kuran-Kadve villages in the form of silk-worm rearing, food processing, dairying, tile making, bamboo working etc.,

and housing is provided it will not be difficult to shift the families to this tract. Discussions with the inhabitants of the interior villages revealed that if adequate employment opportunities are provided the families will be willing to shift, they would however prefer to reside in this region and not move to the arid plains. The types of facilities that need be provided at different villages is indicated in Table 6.6. Protected water supply must be provided for the entire population. Settlements like Dhindli, Chikhali which have just a few households may have to be relocated.

Selected centres e.g., Shirkoli, Mangaon and Tekpole should be developed as nodal centres for study and sports activity in the catchment. Platforms to pitch tents, basic sanitary amenities and safe drinking water should be provided at these centres. The Devrais at these centres offer excellent scope for nature study and bird watching. The Shirkai temple at Shirkoli, the Vardani doh at Tekpole are of definite historical interest. Rayaqad, a fort of historical importance, is easily accessible from Tekpole and Mangaon. These centres are conveniently located from the point of view of activities like rowing, hiking, trekking, mountaineering, angling etc., for which the entire region offers a rich potential. The infrastructural facilities should thus be developed so as to provide the basic amenities to the local population and to support healthy sport, nature observation and

study in the region. The plan must at the same time provide for the protection of the region from commercial/speculative encroachment.

Table 6.6: Suggested Nodal Places and Village Clusters in Panshet Catchment Area

Nodal place	Dependent villages	
Panshet township	Panshet, Ambegaon B. Dhindli	Kuravati, Ambegaon Kh.
Shirkoli	Givashi, Thangaon,	Ghodshet, Pole
Koshimghar	Kambegi, Chikhali	Bhalawadi,
Mangaon	Kasedi, Gondekhal	Godhkhal,

Facilities needed at (a) Panshet township: Post and telegraph office, veterinary-aid-centre, primary health subcentre, high school and technical training, collection centre for milk, collection and storage for forest produce, silk-worm rearing centre, basketry, carpentry workshop, fruit processing centre, cooperative credit society.

(b) Nodal village: Primary school (with at least two teachers), post office, collection centre for forest produce, flour mill, fair price shop, dispensary.

8. Problems of Environmental Degradation in Western Ghats:

A major problem noted in the study of Western Ghats that falls in the Pune district is that of urban encroachment. Lands in the catchment area are being purchased by the urban speculators. The process of urbanization and industrialization threatens to destroy the unique, natural landscape of these areas. It is involving wholesale destruction of the vegetation, and degradation of dry agricultural lands, rudely disturbing the eco-system of the area. The urban encroachment will affect the water sources and accelerate the rate of siltation and pollute the lakes. There are several major dams viz., Andra, Walwan, Shiravata, Bhatghar, Panshet, Warasgaon, Mulshi and Pawana in the Western Ghat region of Pune District, while Chaskaman, Yedgaon, Waduj, Manikdoh, Dimbhe and Pimpalgaon-Joge are under construction. The urban encroachment in all the catchment areas has to be controlled forthwith.

Control of Urban Encroachment and Preparation of Development Plan: (1) Legal provision for Prohibition of transfer of land from agricultural to non-agricultural uses must be made forthwith. In case the agriculturist desires to sell his land, the government should purchase the land and develop it or lease it out for agricultural or agro-forestry purposes only. (2) The development plan for the Western Ghat Region in Pune District as suggested above, should include (a) plan for restoration of

vegetation, (b) protection of lakes, (c) economic betterment of the local inhabitants on the basis of conservation and development of the forest and land resources, (d) development of road-heads only at selected points to serve the villages in the region and restrictions on motor vehicular traffic in the rest of the area, (e) the Region should be reserved for trekking, mountaineering, rowing, study of nature, historical monuments, etc., but not allowed to be used for vulgar tourism (i.e. transgression of the region by motor-launches, gaudy commercial eating/drinking places littering the hills and lakes with cigarette stubs, soiled paper, plastic bags, leftover of food etc.). This can be achieved by judicious planning of the roads and restrictions on motor vehicular traffic.

Urgent steps for the preservation of the Western Ghat region from urban encroachment must be taken so that the hill slopes and lakes are protected and programme for reforestation of the region could be taken up. Secondly, the region should be developed with a view to make it available to the public at large for healthy recreation, physical culture and study and steps must be taken to see that it is not captured and spoiled by the speculators, builders and the urban rich for their week-end bouts.

9. Revaluation of the Policy
Regarding Major Dams:

A number of major irrigation projects have been completed in the Maharashtra State in the last 35 years and new

projects are being taken up. The present study clearly brings out the fact that when these projects were executed no plans were made to protect the catchment area and to properly rehabilitate the displaced families. In taking up new projects both these aspects must be given a thorough prior consideration. A systematic study of the forest wealth, and the possible effects on soils, hydrology and drainage system is essential. Particularly the projects in the Western Ghat region and projects like Inchampalli (Sironcha Taluka, Gadchiroli District) that threaten large forest tracts and a large number of adivasis should not be sanctioned in view of the adverse economic and ecological effects. In such cases alternatives like a chain of small storages should be examined. The consent of the families likely to be affected by the project must be obtained before taking a final decision regarding the implementation of any project.

CHAPTER VII

Recommendations

(A) Protection of Catchment Area:

For providing protection to the catchment area to facilitate revegetation so as to arrest rapid soil erosion and siltation of the reservoir the following measures are essential:

- 1) Total ban on commercial felling of trees and making of charcoal in the catchment area.
- 2) Switch over from shifting cultivation to plantation, agro-forestry and pasture development.
- 3) Switch over from uncontrolled grazing to rotational grazing from August to December and stall feeding from January to July.

(B) Economic Rehabilitation of the Local Population:

If there is a ban on felling of trees, and shifting cultivation is to be discontinued there is a need to provide alternative sources of income to the inhabitants of the catchment area. Following steps are necessary for this purpose:

- 4) The Government should take over the private lands on a long term lease (say 20 years) and take the full responsibility of developing these lands which would include soil conservation measures, plantation and reforestation. The inhabitants should be provided year round work under EGS to implement the plan of

revegetation. The capital expenditure should be met from the funds made available by the Central Government under the Western Ghats Development Programmes.

- 5) Comprehensive redevelopment plan should be prepared and implemented in a phased manner. The region can be divided for this purpose in protection lands (mainly the upper and the steep slopes) and the production lands. In the latter economically useful plants like fuel, fodder and timber trees, medicinal plants, fruit trees, grasses should be reestablished. Emphasis should be given on indigenous species. Priority should be given to row planting along the road, nalas, strip plantation along the reservoir banks and along contours.
- 6) The inhabitants should be assured of employment and earning levels so as to meet the critical minimum needs till the region becomes self-sustaining. As the trees mature, supplementary activities using local resources such as silk-worm rearing, fruit processing, collection and primary processing of medicinal herbs, basketry, rope and other articles of fibre, bee-keeping should be supported, so that gradually the region will generate adequate income from within.
- 7) As shifting cultivation gets discontinued change in the livestock composition from bullock-oriented to milch cattle oriented should be encouraged. With the improvement of grass lands and leaf-fodder supply and provision

- of veterinary service milch business can be established particularly in zone I and zone II.
- 8) Zone IV should be declared as a sanctuary giving full protection as this very heavy rainfall region near the crest is fragile and is in a danger of becoming biologically barren. The inhabitants of this zone (three villages with 144 households) indicated willingness to shift if proper employment and housing is provided. It is suggested to use the lands in Kuran, Kadve and Panshet acquired by the irrigation department but not submerged, for their resettlement. They can be established in dairy business and cottage industry through various Government programmes and Khadi Gramodyog Schemes.
- 9) Full protection should be given to all the devrais in the catchment area to preserve biological diversity.

(C) Provision of Infrastructural Facilities:

It is necessary in addition to provide certain infrastructural facilities which are lacking today.

- 10) Treat Panshet township as the nodal centre that serves the entire catchment area. Veterinary-aid-centre, primary health sub-centre, collection centre for forest produce, cooperative credit society, silk-worm rearing centre, extension centre for agro-forestry and horticultural and pasture development be set in Panshet-Kuran.
- 11) Provision of safe drinking water supply to all villages.

- 12) Supply of fuel efficient chulas for cooking.
- 13) Provide for chemical treatment of grass, bamboo etc., used for walls and thatching the roof so that it become fire-resistant. (If the housing material is soaked for a day in a mixture made in the proportion of 18 kg. of Diammonium phosphate with 100 litres of water and dried in shade, the material becomes fire-resistant.)
- 14) Encourage separation of cattle-shed from the house.
- 15) As cutting of hills for laying roads causes degradation of hills, motorable roads that are built today should be properly improved. Motorable roads should not be extended.
- 16) Regular launch service be provided for the inhabitants and students and hikers visiting the area for study and healthy sport and recreation.
- 17) Private motor vehicles (including trucks) should not be permitted beyond the Panshet dam for commercial and recreational purposes.

(D) Protection from Commercial Encroachment:

It is equally important to protect the catchment area from urban encroachment. For this purpose the following measures are essential:

- 18) Legal provision be made forthwith for Prohibition on transfer of land to non-agri-horti-forestry uses. In case the land owners desire to sell his land, the

- government should purchase the land and develop it according to the revegetation plan.
- 19) The region should be reserved for trekking, mountaineering, rowing, study of nature but not allowed to develop for vulgar tourism - e.g. transgression of the region by private motor vehicles, pollution of lake by frequent use of motor launches, gaudy commercial eating-drinking places. This can be achieved by judicious planning of roads, restrictions on motor vehicular traffic and providing limited launch trips.
- 20) The region should be developed to make it available to public at large and particularly to the students for physical culture, study and not captured by the speculators, builders and the urban rich for their week-end bòuts.
- 21) Facilities like platforms to pitch tent, and the basic sanitary amenities and safe drinking water be provided at the selected centres e.g., Shirkoli, Mangaon and Tekpole. The Devrais there offer excellent scope for nature study, bird watching. These will serve as nodal points for rowing, mountaineering, trekking etc., in the catchment area.

(E) Consideration of the Consequences of Large Dams:

In view of the very adverse economic and ecological impact on the catchment area due to the construction of a large

reservoir it is necessary to take the following precautions before sanctioning a major irrigation and/or hydro-power project.

- 22) Adequate measures must be taken to rehabilitate the inhabitants likely to be displaced due to the construction of a dam. The principle of economic compensation for the property lost is extremely inadequate. The inhabitants must be assured a flow of income through proper employment so as to meet the basic needs. They must be provided with adequate housing and other amenities. Consent of the population likely to be affected by the project must be obtained before sanctioning the project.
- 23) The possible ecological consequences of a large storage must be researched in depth, and alternatives like a chain of smaller storages should be examined, before any major work is sanctioned.
- 24) Any project involving felling of extensive forest areas should be rejected on ecological grounds. The proposed Inchampalli irrigation project in Gadchiroli district should not be accepted as it involves submergence of extensive forest areas in Sironcha Taluka.

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Glossary of Marathi Words in the Report

- Bhagar - Cooked vari
- Bhakar - Millet bread
- Bhat - Cooked rice
- Chatni - A seasoning with ground challis
- Chula - A mud cooking stove
- Devrai, Devrahati - A grove dedicated to god
- Devacha Mankari - A person entitled to certain privileges for performing rituals
- Doh - Deep part in a river
- Doinangar - A plough drawn by two men
- Hataraki - A system of pooling labour of the entire village to complete weeding operation expeditiously on invitation of a cultivator who supplies meals on the work-day and makes a small cash payment to those joining the pool
- Kaccha road - Fair weather rough road
- Kalwan - Liquid side-dish
- Kambal - Rough blanket
- Khan - Space between two columns or cross beams
- Kulav - Hoe
- Mawa - Sweetened condensed mango pulp
- Moli - Head load of fuelwood
- Murum - Disintegrated rock
- Padavi - Shed against wall
- Oti - Portion of house adjoining padvi at a higher level (by about one foot)
- Parda - Backyard
- Pendhi - Bundle of grass
- Petari - Large field hoe drawn by bullocks to smooth field
- Pukka road - All weather road
- Raab - Loppings and leaves used in burning the ground
- Sat - Pulp of mango or jackfruit flattened on a plate or mat-piece by patting and sun-dried
- Shendoor - Vermillion pigment ... made of ~~red~~ lead
- Van Panchayat - Village level committee to organize tree plantation work
- Varkas land - Inferior murmy upland

List of plants with their local names
and Botanical Names

<u>Acacia intsia</u> Willd	Chilhar
<u>Acacia nilotica</u> Det.	Babhul
<u>Acacia rugata</u> Ham. (<u>Acacia concinna</u> Dc)	Shikekai
<u>Actinodaphne angustifolia</u> Nees	Pisadi
<u>Adhetoda vasica</u> Nees	Adulsa
<u>Adina cordifolia</u> Benth	Hedu
<u>Aeginetea indica</u> L	-
<u>Aegle marmelos</u> Lorr	Bel
<u>Agave americana</u> L	Latia-Guial
<u>Ageratum conyzoides</u> L	Sahadevi
<u>Albizzia lebbek</u> Benth	Shirish
<u>Allophyllus serratus</u> Radlk (<u>Allophyllus cobbe</u> Bl)	Tipan
<u>Alstonia scholaris</u> R.Br	Satvin
<u>Alysicarpus hamosus</u> Edgew	-
<u>Alysicarpus rugosus</u> Dc	-
<u>Alysicarpus vaginalis</u> Dc	-
<u>Amarantus paniculatus</u> L	-
<u>Amarantus spinosus</u> L	-
<u>Anacardium occidentale</u> L	Kaju
<u>Anagallis arvensis</u> L	-
<u>Ancistrocladus heyneanus</u> Wall	Kardal
<u>Anogeissus latifolia</u> Wall	Dhavda
<u>Anthocephalus cadamba</u> Miq	Kadam
<u>Argemone mexicana</u> L	Pivla-dhotara
<u>Artemisia parviflora</u> B.Ham	Tel-Davana

<u>Artocarpus heterophyllus</u> Lam (<u>Artocarpus integrifolia</u> L.f)	Phanas
<u>Arthraxon lancifolius</u> Hochst	-
<u>Arundinella</u> Sp	-
<u>Asparagus racemosus</u> Bak	Satavari
<u>Atalantia monophylla</u> De	Makad limbu
<u>Atalantia racemosa</u> W&A	Makad limbu
<u>Azadirachta indica</u> A.Juss	Neem
<u>Bauhinia racemosa</u> Lam.	Apta
<u>Bassia longifolia</u> L	Moha
<u>Biophytum sensitivum</u> De	-
<u>Bombax ceiba</u> L	Savar
<u>Brachiara ramosa</u> Stapf	
<u>Breynia patens</u> Rolfe	Kangli
<u>Bridelia squamosa</u> Skeels	Asna
<u>Buchanania lanzan</u> Spreng	Char
<u>Butea monosperma</u> Taub	Palas
<u>Calotropis gigantea</u> R.Br	Madhav
<u>Calotropis procera</u> R.Br	Rui
<u>Canavalia stocksii</u> Dalzell	-
<u>Careya arborea</u> Roxb	Kumbi
<u>Carissa congesta</u> Wigesto	Karvand
<u>Caryota urens</u> L	Berlimad
<u>Casearia graveolens</u> Dalz	Bokhada
<u>Caesalpenia sepiaria</u> Roxb	Chillara
<u>Carvia callosa</u> Bremek	Karvi
<u>Cassia fistula</u> L	Bhava
<u>Cassia tora</u> Bak	Taroti
<u>Cassine glauca</u> O.Ktze	-
<u>Casuarina equisetifolia</u> Forst	-

<u>Ceropegia lawii</u> Hk&f	Kharpudi
<u>Ceropegia tuberosa</u> Roxb	-
<u>Cholorophytum glaucum</u> Dalz	-
<u>Chloris virgata</u> Sw	-
<u>Chrysopogon montanus</u> Trin	
<u>Cicer arietinum</u> L	Harbara
<u>Cipadessa baccifera</u> Miq	Gudmei
<u>Clematis trilobus</u> Heyne	Ranjai
<u>Commelina nudiflora</u> L	Gandolgi
<u>Cordia dichotoma</u> Forst	Bhokar
<u>Crotalaria retusa</u> L	Dingala
<u>Cucumis melo</u> (cult)	Meki
<u>Cyanotis fasciculata</u> Schult	-
<u>Cyperus rotundus</u> L	Nagarmatha
<u>Dalbergia latifolia</u> Roxb	Shisham
<u>Dalbergia sissoo</u> Roxb	Sisvi
<u>Dendrocalamus strictus</u> Nees	Kaniabang
<u>Dichanthium annulatum</u> Stapf	-
<u>Dillenia pentagyna</u> Roxb	Karmal
<u>Dioscorea pentaphylla</u> L	Shandvel
<u>Diploclasia glaucescens</u> Diels	-
<u>Dolichos lablab</u> L	Pawata
<u>Dysoxylum binectariferum</u> Hk&f	Yerendi
<u>Elaeagnus latifolia</u> L	Amgul
<u>Eleusine coracana</u> Gaert	Nachani
<u>Embelia tsjeriam-cottam</u> Dc	Vavdang
<u>Emblica officinalis</u> Gaertn	Awla
<u>Ensete superbum</u> Cheesman	Chaeen
<u>Entada phaseoloides</u> Merr	Garambi
<u>Eriocaulon</u> Sp	-

<u>Erythrina variegata</u> L	Pangara
<u>Eulophia pratensis</u> Lindl	Satvari
<u>Euphorbia nivula</u> Buch	Navang
<u>Euphorbia rothiana</u> Spreng	Dudhi
<u>Ficus arnottiana</u> Miq	Pipal
<u>Ficus glomerata</u> Roxb	Umbar
<u>Ficus hispida</u> L	Kala umber
<u>Ficus retusa</u> L	Nandruk
<u>Flacourtia latifolia</u> T.Cooke	Tambat
<u>Flemingia strobilifera</u> Br	Kanphuti
<u>Fluggea leucopyrus</u> Dalz	Pandharphalli
<u>Garcinia indica</u> Choiss	Kokam
<u>Girardinia zeylanica</u> Deve	Motha Khujoti
<u>Gliricidia sepium</u> Steud	
<u>Gloriosa superba</u> L	Bachnog
<u>Gmelina arborea</u> Roxb	Shivan
<u>Gravalia robusta</u> A.cunn	
<u>Grewia tiliaefolia</u> Vahl	Dhaman
<u>Guizotia abyssinica</u> Cass	Karla til
<u>Habenaria grandiflora</u> Lindl	-
<u>Hardwickia binata</u> Roxb	Anjani
<u>Heterophragma quadrilocularis</u> K.Schum	Varas
<u>Heteropogon contortus</u> P.Beauv	Kursali
<u>Hiptage madablota</u> Gaert	Haladvel
<u>Hippocratea grahami</u> Wt	Lokandi
<u>Holarrhena antidysenterica</u> Wall	Kuda
<u>Homonoia riparia</u> Roxb	Serni

<u>Impatiens balsamina</u> L	Terda
<u>Indigofera cordifolia</u> Heyne	Godadi
<u>Indigofera pulchella</u> Roxb	Chimanti
<u>Iseilema laxum</u> Hack	Tambil
<u>Ixora nigricans</u> Br	
<u>Jasminum malabaricum</u> Wt	Kusar
<u>Justicia diffusa</u> Willd	-
<u>Lagerstroemia lanceolata</u> D&G	Nana
<u>Lagerstroemia parviflora</u> D&G	Bondara
<u>Lantana camara</u> L	Tantani
<u>Lasiosiphon eriocephalus</u> Dene	Rametha
<u>Leea indica</u> Merr	-
<u>Leea edgeworthii</u> Sant	-
<u>Lens esculanta</u> Moench	Masur
<u>Leucaena leucocephala</u> Wt	Su babul
<u>Leucas aspera</u> Spr	-
<u>Leucas montana</u> Spr	-
<u>Litsea zeylanica</u> Nees	Mala
<u>Lobelia nicotianaefolia</u> Heyne	Dhavala
<u>Luffa acutangula</u> Roxb	Turai
<u>Macaranga peltata</u> Muell	Chanda
<u>Mallotus Philippinensis</u> Muell	Shendri
<u>Mangifera indica</u> L	Amba
<u>Melia composita</u> Willd	Limbara
<u>Melothria heterophylla</u> Cogn	Gomati
<u>Memecylon umbellatum</u> Burm	Anjan
<u>Meynea laxiflora</u> Robyns	Aloo

<u>Morus alba</u> L	-
<u>Murraya exotica</u> L	Kunti
<u>Murraya koenigii</u> Spr	Khadi nim
<u>Nothapodytes foetida</u> Sleumer	Kalgur
<u>Olea dioica</u> Roxb	Par Jamb
<u>Oryza sativa</u> L	
<u>Oropetium thomaeum</u> Trin	-
<u>Osyris arborea</u> Wall	Popli
<u>Oxalis corniculata</u> L	Ambusi
<u>Oxytenanthera monostigma</u> Bedd	Choua
<u>Panicum miliaceum</u> L	Vari
<u>Panicum miliare</u> Lam	Sawa
<u>Pavetta bengalensis</u> Bremer	Papat
<u>Pennisetum spicetum</u> Roem&Schulf	Bajra
<u>Pergularia daemia</u> Chiov	Utarni
<u>Phaseolus aconitifolius</u> Jacq	Math
<u>Phaseolus radiatus</u> L	Ranmug
<u>Phaseolus khandalemsis</u> Sant	Ranshevga
<u>Phoenix humilis</u> Royle	-
<u>Phoenix sylvestris</u> Roxb	Shinde
<u>Piper betle</u> L	-
<u>Plectronia wightii</u> W&A	Tupa
<u>Pogostemon parviflorus</u> Bth	Pangli
<u>Pongamia pinnata</u> Piers	Karanj
<u>Portulaca oleracea</u> L	Gholu
<u>Pulcaria wightiana</u> Clke	-

<u>Salix</u> <u>babylonica</u> L	-
<u>Salix</u> <u>tetrasperma</u> Roxb	Walunj
<u>Scutia</u> <u>myrtina</u> Kurz	Chimat
<u>Semecarpus</u> <u>anacardium</u> L.F	Bibba
<u>Senecio</u> <u>edgeworthii</u> Hk.F	-
<u>Sideroxylon</u> <u>tomentosum</u> Roxb	Roxb
<u>Solanum</u> <u>indicum</u> L	Chinchurdi
<u>Striga</u> <u>lutea</u> Lour	-
<u>Striga</u> <u>orbanchioides</u> Bth	-
<u>Striga</u> <u>gesneroides</u> Vatke	-
<u>Smithia</u> <u>hirsuta</u> Dalz	-
<u>Smithia</u> <u>setulosa</u> Dalz	-
<u>Smithia</u> <u>bigemina</u> Dalz	Barka
<u>Smilax</u> <u>macrophylla</u> Roxb	Ghotvel
<u>Sterculia</u> <u>foetida</u> L	Jangli badam
<u>Sterculia</u> <u>guttata</u> Roxb	-
<u>Syzygium</u> <u>cumini</u> Skeels	Jambool
<u>Terminalia</u> <u>alata</u> Heyne	Ain
<u>Terminalia</u> <u>bellerica</u> Roxb	Behda
<u>Terminalia</u> <u>chebula</u> Retz	Hirda
<u>Tetrapogon</u> <u>tenellus</u> Chiov	-
<u>Themeda</u> <u>quadrivalvis</u> O.Ktze	-
<u>Tinospora</u> <u>cordifolia</u> Miers	Gulvel
<u>Tragia</u> <u>involucrata</u> L	Kolti
<u>Trichodesma</u> <u>indicum</u> Br	Chota kalpa
<u>Tylophora</u> <u>dalzellii</u> Hk&f	

Utricularia Sp

Vigna capensis Walp

Halunda

Vitex negundo L

Nirgudi

Woodfordia fruticosa Kurz

Dhayati

Wrightia tinctoria Br

Kala kuda

Xeromphis spinosa Keay

Ghela

Xylia dolabriformis Benth

Yerendi

Zanthoxylum rhetsa Dc

Kokli

Zizyphus mauritiana Lamk

Bor

Zizyphus rugosa Lam

Turan