GOVERNMENT OF KERALA

EVALUATION OF SOIL CONSERVATION WORK IN THE CATCHMENT AREA OF KUNDHA PROJECT (KERALA PORTION)

REPORT No. I

DEPARTMENT OF
ECONOMICS AND STATISTICS
TRIVANDRUM
1989

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JANUARY 1989.

P R E F A C E

The importance of soil conservation as a measure of land development has been recognised. The Soil Conservator programme in the Kerala portion of the Kundha Hydro Electric project was started in 1967 and a total of 13125 hectares of land both in the first priority area and under watershed principle have been treated at a cost of Rs.480 lakhs, till 1987-88.

The present study seeks to evaluate the progress of the scheme and its impact on agricultural production in the catchment areas and silt formation in the Hydel reservoir.

The survey was conducted in four watersheds viz:Kuruthorai, Thalayani, Mully and Paloor where the soil conservation measures were completed. The survey will be continued in the remaining watersheds.

This report is the first one prepared by this Directorate.

I acknowledge the advice and suggestions from the Additional Director of Soil Conservation for the conduct of the survey. The co-operation of the soil conservation officers at Palghat is also gratefully acknowledged.

Trivandrum,
25--2--1989.

K.BALAKRISHNAN NAIR
Director of Economics & Statistics.

MNR.17/3.

C O N T E N T S

Chapter-I

Introduction

Soil conservation is a measure for land improvement. A comprehensive programme for soil conservation was conceived and initiated at National Level from the first plan onwards. If gained momentum by the 2nd plan. In course of time, this programme became a package of schemes with long term objectives of obtaining substantial increase in agricultural production and reducing the silt rate in the reservoirs of Hydrological Projects.

Kundha Project is one among the 14 major Hydro Electric Projects in the country where soil conservation works have been initiated. The project comprises of a total area of 1200 sq.kms. of which 550 sqr. kilometres in Kerala State and the rest in Tamil Nadu State.

The major objectives of Soil Conservation Schemes in the catchment areas of Kundha project were(i) to arrest the siltation into the Kundha Hydro Electric reservoir so as to increase its life and (ii) to prevent soil erosion and to accelerate the top soil formation by natural process and improving the fertility of the soil in the area.

The investigation works in the Kerala portion of Kundha Project were started in 1965-66 and completed in 1967-68 with annual expenditures of Rs.0.51 lakh, 0.47 lakh and 0.57 lakh respectively.

The detailed survey and execution of soil conservation works in Kerala portion of Kundha project were under taken by the Kerala Agriculture (Soil Conservation) Department on a centrally sponsored scheme from 1967-68 onwards.

1.1 Kundha Hydro Electric Project

The work on Kundha Hydro Electric Project of Nilgiri District of Tamil Nadu State was commenced in May 1956 and completed by the end of the Third Plan. Generation of electricity is the main purpose of this project and flood control is incidental.

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The river basin of this project has been divided into 20 sub-catchments, of which a major portion known as "Pillur free catchment" is lying in Attapady valley of Kerala State. This portion in Kerala is drained by the Bhavani and Seruvani rivers.

1.2 Kundha Project: Kerala portion

Location

Kerala portion of the catchment of Kundha project forms part of the Attapady Tribal Development Block of Palghat District and is located at the North Eastern portion of Mannarghat Taluk. The climatic conditions, soil characteristics and topography of the area are suitable for the growth of all forest spices and agricultural crops. The low lying paddy fields have high potential for raising double crop. The upper reaches are suitable for plantation crops like rubber, coffee, tea and cardamom. The entire catchment area which was originally under dense forest has now been completely denuded except in certain portions. The elevation varies from 450 metres to about 2350 metres at "Anginda" peak and the entire area gets a good salubrious micro climate and good rainfall.

1.3 Rivers: Bhavani, Verager and Seruvani are the three major rivers that drain the area. The Bhavani river originates from the Tamil Nadu portion of the catchment and enters into Kerala State taking a southernly course upto Mukkali at which point it takes an abrupt turn to east and after receiving the waters from Seruvani and Karingarapalam, flows at the boundary of Kerala State for a small distance and join the Kundha river in Tamil Nadu. The Seruvani river originates from the Attappady reserve forests in Palghat District and flows almost northwards after receiving water from Karingarapalam and then to the eastern boundary of the State for a short distance. During 1972 the Tamil Nadu Government have diverted the Veragar river to Tamil Nadu and there is very little flow of water in the Kerala portion through this river.

1.4 The unscientific soil management practices has resulted in the silting up of the rivers, depletion of the soil in the cultivated regions and thus shertening the life of the Hydel Reservoir of the Kundha Project. The denudation of private forests has accelerated the erosion of soil in the catchment area.

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1.5 Sub-catchments:- The Kerala portion of the catchment of Kundha project has been divided into 10 sub-catchments with a total area of 56980 hectares as shown below.

Table 1.1

Distribution of area according to sub-catchment

Sl. No.	Sub-catchment Number	Area in hectare
1	I	14193
2	II	3680
3	III	5603
4	IV	4586
5	V	5646
6	VI	5313
7	VII	6306
8	VII A	6144
9	VIII	3633
10	IX	1876
	Total	56,980

Out of these 10 sub-catchments No. I & VI are under Government reserve forests and the working plans of the forest department are in vogue in these areas.

Based on the aerial photo interpretation andalso joint field inspection by the state and central governments, priorities for the execution of soil conservation works were fixed for a total area of 35,598 heactares as shown below.

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Table 1.2

Priorities for the commencement of soil conservation work in different sub-catchments

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Order of priority	Sub-catchment number	Area(Hactare)
1	VII	6306
2	VII A	6144
3	VIII	3633
4	III	5603
5	IV	4586
6	V	5646
7	II	3680
	Total	35,598

In the first priority catchment area of Kundha Project (Kerala portion), according to Dr.S.V.Govindarajan, Chief Soil Survey Officer of Government of India, immediate attention was required in 4575 hectares. This comprises mostly of Agricultural lands under cultivation of different crops. A slope-wise distribution of this area is given below:

Table 1.3

Distribution of first priority areas according to their slopes.

Slope range	Estimated priority area(in hactare)	Percentage
1. upto 15%	3050	67
2. 15% to 35%	1375	30
3. Above 35%	150	3
Total	4575	100

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The estimated cost of soil conservation works in the first priority area originally fixed is furnished below:

Table 1.4

Agricultural land

1) Contour terracing - Puerto Riccen. type		
1) Land upto 15% slope	22.875	lakhs
2) Land from 15% to 35% slope	16.500	"
3) Land above 35% slope	2.100	"
ii) Check dams - provision	2.000	"
iii) Stabilisation of gullies	0.200	"
	43.675	"

Rounded to Rs. 44 lakhs.

1.6. Land use particulars

The land use particulars of the catchment area(Kerala portion) as on 1973 is given in Table 1.5

Table 1.5

Land use particulars in the catchment area of Kundha project(Kerala portion).

Particulars	Area(Heactares)	Percentage
1. Reserve forest	20275	36
2. Private forest	28498	50
3. Area cultivated with annual crop	7479	13
4. Area under plantation	728	1
	56980	100

contd.....6/-

1.7 Watershed management in action:

The soil conservation works in the first priority area already fixed have been completed in 1974-75.

Since 1975, the sub-catchment principle was replaced by sub-watershed principle. Schemes for mini watersheds have been formulated according to the priority fixed and are being implemented. The soil conservation works in the following watersheds have been taken up during 1975-76 and in 1987-88.

1.	Watershed No.I	Kuruthorai
2.	" " II	Thalayani
3.	" " III	Kulkkoor
4.	" " IV	Mully
5.	" " V	Paloor
6.	" " VI	Kavundickal.
7.	" " VII	Jellappara
8.	" " VIII	Kathirampathy
9.	" " IX	Moolakombu

The soil conservation works in the first five watersheds have been completed by the end of 1977-78 and those of the remaining watersheds are in progress.

1.8 Socio Economic condition in the catchment area:

The scheme area was a tribal tract. Migration of cultivators from the dam hills and other places to this tract upsets the socio economic setup of the tribes. The scheduled tribe population in the catchment area has how been decreased to 1/3 of the total population. The excessive influx of settlers has caused serious land alienation problems.

Chapter II

Kundha Soil Conservation Scheme:

2.1 Genesis of the Scheme:

The Government of Kerala in G.O.MS.No.98/68/Agri. dated 24-2-1968 have accorded sanction for the implementation of a scheme for Soil conservation works in the catchment of Kundha River Valley Project (Kerala Portion) subject to constraints contained in the Government of India's letter dated 16-12-1967. Much work could not be done during 1967-68 due to proceedural delays in getting administrative sanction for the implementation of the scheme in time.

However, soil conservation works, in the first priority area of the catchment were completed in 1974-75. In 1975 the catchment area principle was replaced by watershed principle. Since then, the works were carried out in the watersheds. Seperate schemes for soil conservation works in mini watersheds were prepared and implemented.

2.2. Soil Conservation measures proposed

The Tillage practices in the area coupled with the run off due to precipitation, have given rise to soil erosion in the area. Sheet, gully and rill erosion are observed in the area. If the present practices and types of erosion are allowed to continue without any soil conservation measures, the valuable top soil will be washed off, with the result that the cultivation in the area will become impossible. With a view to prevent this phenomenon, this Scheme contemplates the adoption of all the required soil conservation measures in the watersheds of the project area on a priority basis, in addition to conserving soil and reducing silt load to the reservoir.

Checkdams are proposed across water courses to control and regulate the velocity of the flowing of water so as to reduce its erosive capacity. The deep gullies in the area have to be plugged to avoid theirdeepening and consequent damages.

2.3. Agency for work and source of finance for the Scheme:

The scheme is implemented with 100% central assistance comprising of 50% of grant and 50% of loan. According to the scheme, this work is to be undertaken by the cultivators in actual possession of land or through their nominees(Contractors) under the technical control and supervision of the Soil Conservation Department.

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2.4. Machinery for continuous evaluation:

The implementing authority of the centrally sponsored scheme is the State Department of Agriculture (Soil conservation Division) Thile according sanction for the Soil Conservation scheme, Government of India have directed that a detailed evaluation report is required annually in accordance with the recommendation of the standing committee for soil conservation in river valley projects.

The present study was conducted by the Directorate of Economics and Statistics, Trivandrum.

2.5. Objectives of the study:

The main objectives of the evaluation study are: (1) to review the progress of implementation of soil conservation programmes in the catchment area (Kerala Portion) and (2) to assess the benefits accrued due to the implementation of the scheme with special reference to the effect on the rate of silting.

2.6. Coverage and methodology of the study:

The present round of the study is confined to four watersheds brought under soil conservation works. The watersheds selected are No. I Kuruthorai, No. II Thalayani No. IV Mully and No. V Paloor. The Soil conservation works in Kuruthorai and Thalayani watersheds were started in 1976 and those of Mully and Paloor in 1981. The no. of beneficiaries in these watersheds is given below:

1) Kuruthorari - 894
2) Thalayani - 708
3) Mully - 414
4) Paloor - 661

The survey was conducted in these watersheds by selecting 5% of the beneficiaries by stratified simple random sampling method. The stratam of beneficiaries are:

1) Stratam I - less than 1 Hect.
2) Stratam II - 1 to less than 3 Hect.
3) Stratam III - 3 5o less than 5 Hect.
4) Stratam IV - 5 Hect. & above

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The yearwise distribution of total beneficiaries is given in table 2.1.

Table 2.1

Distribution of beneficiaries: Stratum-wise

Name of watershed	Year	No. of beneficiaries				
		Stratum				
		I	II	III	IV	Total
1	2	3	4	5	6	7
1) Kuruthorai	1976-77	53	134	19	4	210
	77-78	10	13	1	-	24
	78-79	109	135	14	1	259
	79-80	88	98	9	1	196
	80-81	108	76	13	5	202
	81-82	-	2	1	-	3
Total		368	458	57	11	894
2) Thalayani	1977-78	31	94	9	3	137
	78-79	97	126	9	1	233
	79-80	72	94	9	-	175
	80-81	70	46	4	-	120
	81-82	19	22	-	-	41
	82-83	1	1	-	-	2
Total		290	383	31	4	708
3) Mully	1980-81	8	36	[illegible]	-	48
	81-82	93	80	12	-	153
	82-83	48	81	12	-	141
	83-84	30	38	3	1	72
Total		141	241	31	1	414
4) Paloor	1981-82	49	46	2	-	97
	82-83	57	78	4	Nil	139
	83-84	102	84	4	1	191
	84-85	126	73	3	Nil	202
	85-86	20	12	-	-	32
Total		354	293	13	1	661

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The no. of sample beneficiaries selected from each watershed is as follows:

Name of watershed	Total No. of beneficiaries	Sample selected
1) Kuruthorai	894	51
2) Thalayani	708	40
3) Mully	414	24
4) Paloor	661	36
TOTAL	2677	151

Five control plots from each watershed were also taken for detailed study. The control plots were not subject to any soil conservation measures. Data relating to beneficiary plots prior to the implementation of the programme were collected for comparison purposes. Relevant details were collected by contacting the beneficiary cultivators and visiting the plots. The reference period of the study was 1986-87 agricultural year. Data on crop pattern, crop yield, expenditure on various agriculture operation etc. were collected for the reference year.

According to the Joint Director, Soil conservation unit of Palghat the crops grown fortthe year 1986-87 and for the previous yearsfailed due to drought. Hence he desired to collect the details of the crops grown for the Agricultural year 1987-88 in the beneficiary plots. Thus the details of crops grown for the years 1986-87 and for 1987-88 were collected for analysis.

The details of physical and financial achievements and silt load data were collected from the Joint Director, Soil Conservation programme, Palghat and Assistant Directors in charge of the Soil Conservation works in the watersheds and the Engineering Hydrology Division, Kottathara.

In addition to the survey on beneficiary and control plots, the details of check dams constructed in four Survey Nos. in Thalayani watershed were also collected.

2.7 Schedules: The schedules prescribed for the survey were:

SCHEDULE I - List of selected beneficiaries.
-do- II - Household questionnaire.
-do- III - list of selected cultivators in the control plots.
-do- IV - details of control plots.

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The analysis of data and the preparation of the report were done by the Directorate of Economics & Statistics.

Chapter III

Progress of work in the execution of the scheme in the catchment area of Kundha Project (Kerala Portion)

3.1. The actual execution of the soil conservation works are to be done by the beneficiaries themselves or by their nominees (contractors) under the direct supervision of the soil conservation staff. As per the scheme 50% of the cost of the work will be on grant and 50% as loan. The loan has to be repaid by the beneficiaries with 6% interest in 20 half yearly equal instalments within a period of 10 years. It is found that all the soil conservation works in the beneficiary plots were done by the nominees (contractors) of the beneficiaries.

The afforestation work in the forest land was executed by the Forest Department utilising the fund allotted to them from the soil conservation scheme.

Since 1976, the soil conservation schemes in mini watersheds have been formulated and implemented. The following soil conservation works in watersheds have been taken up till the end of 1987-88.

		Commencement of work
1.	Watershed No. I Kuruthorai	1976-77
2.	-do- II Thalavani	1976-77
3.	-do- III Kuthur	1980-81
4.	-do- IV Mulli	1980-81
5.	-do- V Paloor	1981-82
6.	-do- VI Kayundikal	1982-83
7.	-do- VII Vellappara	1983-84
8.	-do- VIII Kathairampathy	1985-86
9.	-do- IX Moolakomba	1987-88

The soil conservation works of the first five watersheds have been completed and the works in the remaining watersheds are in progress during the period under review.

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3.2. The physical and financial achievements of work and establishment charges under the watershed management principle from 1976-77 to 1987-88 are given in Table 3.1.

Table 3.1

Soil Conservation Programme in watersheds of Kundha Project (Kerala Portion) - Physical and financial achievement.

Year	Sub-catchment	Watershed No. and name	Allotment for work Rs.in lakhs	Achievement of work		Expenditure on Estt.(Rs.)	
				Physical	Financial	Plan Rs.	Non-Plan Rs.
1	2	3	4	5	6	7	8
1975-76	VII	1)Kuruthorai		123	67148	-	
		2)Thalayai		136			
		Total	8.00	259	67148		230500.00
1976-77	VII	1)Kuruthorai		166	496254	-	
		2)Thalayai		75	237096	-	
		Total	8.00	241	733350	-	212576.00
1977-78	VII	1)Kuruthorai		67	160836	-	-
		2)Thalayani		20	69435	-	-
		Total	20.00	87	230271	-	222414
1978-79	VII	1)Kuruthorai		325	958840	-	-
		2)Thalayani		280	927143	-	-
		Total	20.00	605	1885983	-	224077
1979-80	VII	1)Kuruthorai		254	559067	-	-
		2)Thalayani		216	671460	-	-
		Total	20.00	470	1230527	-	237938
1980-81	VII, V,IV	1)Kuruthorai		251	712447	-	-
		2)Thalayani		130	499144	-	-
		3)Kulkkoor		168	565727	-	-
		4)Mully		75	338125	-	-
		Total	30	624	2115443	275399	257583

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1	2	3	4	5	6	7	8
1981-82	II, IV,V	2) Thalayani		101	309295	-	-
		3) Kulkkoor		297	1514986	-	-
		Afforestation		29	146526	-	-
		4) Mully		222	1129711	-	-
		5) Paloor		106	560882	-	-
		Total	48	755	3661400	636591	269690
1982-83	II, IV	2) Thalayani		13	47135	-	-
		3) Kulkkoor		167.28	916149	-	-
		Afforestation		23.50	199696	-	-
		4) Mully		160.00	916946	-	-
		5) Paloor		174.00	928360	-	-
		6) Kawndickal		176.50	933591	-	-
		Total	48	714.28	3941877	691379	297827
1983-84	II,IV V,VIIA	3) Kulkkoor		195.00	1163998	-	-
		4) Mully		50.00	330041	-	-
		5) Paloor		214.00	1131997	-	-
		6) Kawundickal		230.00	1221803	-	-
		7) Jellappara		150.00	891122	-	-
		Total	60	839.00	4738961	802160	328845
1984-85	II,V, VIIA VII	3) Kulkkoor		276.00	1600000	-	-
		5) Paloor		200.00	1089999	-	-
		6) Kawundickal		267.00	1472702	-	-
		7) Jellappara		277.00	1484880	-	-
		Total	65	1020.00	5647581	911806	377082
1985-86	V,II, VII	3) Kulkkoor		326	1699933	-	-
		5) Paloor		81	119995	-	-
		6) Kawundickal		347	1699998	-	-
		7) Jellappara		270	1374997	-	-
		8) Kathirampathy		342	1529997	-	-
		Total	81	1365	6424920	1109538	474615

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1	2	3	4	5	6	7	8
1986-87	V,VIIA	3) Kulkkoor		340	1579969	-	-
		6) Kavundickal		325	1549967	-	-
		7) Jellappara		315	1550000	-	-
		8) Kathirampathy		350	1549997	-	-
		Total	80	1330	6229933	1390805	527405
1987-88	V,VIIA	3) Kulkkoor		137	799998	-	-
		6) Kavundickal		240	1546153	-	-
		7) Jellappara		330	1556252	-	-
		8) Kathirampathy		311	1560945	-	-
		10) Moolakkompu		140	762536	-	-
		Total	80	1158	6225884	1613853	591915

3.3. The watershed-wise area treated with year of treatment is given in table 3.2.

During the years 1975-76 to 1987-88 a total area of 9416 Hect. of Agricultural land have been treated under watershed principle at a cost of Rs.434 lakhs. Per hectare cost for work is Rs.4609/-. The total expenditure on establishment excluding the expenditure on the Head Quarters staff at Trivandrum is Rs.116.84 lakhs of which 42.54 lakhs is under Non-Plan and the rest of Rs.34.31 lakhs is under Plan. The establishment charge is found to be 27% of the expenditure on works.

3.4. Thus a total of Rs.13,125 Hectares of land both in the first priority area and under watershed principle have been treated at a cost of Rs.480 lakhs in the whole catchment area of Kundha Project (Kerala Portion) till 1987-88 from the inception of the programme.

3.5. The afforestation work in the whole catchment area is only 52.50 Hectares and the expenditure incurred is Rs.3.46 lakhs. Per hectare cost for afforestation work is Rs.6595/-. The per hectare cost fixed for afforestation work as per the general guidelines, issued by the Government of India was only Rs.200/-. The expenditure seems to be very high. The Forest Department has attended this work. But the Forest Department is reported to have not taken up further works included in the various schemes due to administrative difficulties.

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TABLE 3.2

Soil Conservation Programme Kundah Project (Kerala Portion) Physical achievement for the years from 1976-77 to 1987-88 under water shed management Plan

Sl. No.	No. and name of water shed	Physical achievement (Area - Hect. /No.													
		1975-76	1976-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	Total
2		3	4	5	6	7	8	9	10	11	12	13	14	15	16
	No.I-Kuruthorai	123.00	166.00	67.00	325.00	254.00	251.00	..	..	..	..	..	..	..	1186.00
	II-Thalayani	136.00	75.00	20.00	280.00	216.00	130.00	101.00	14[illegible]	..	..	..	..	..	971.00
	III-Kulkkoor	..	..	..	..	..	168.00	297.21	169.28	135.0	276.0	325.66	340.0	137.0	1906.00
	Afforts-tation	..	..	..	..	..	..	29.00	23.50	..	..	..	..	..	52.50
	IV-Mulli	..	..	..	..	..	75.00	222.00	160.00	50.0	..	..	..	..	507.00
	V-Paloor	..	..	..	..	..	..	106.00	174.00	214.0	200.0	81.00	..	..	775.00
	VI-Kavundi-cal	..	..	..	..	..	..	..	176.50	230.0	267.0	347.0	325.0	240.0	1585.50
	VII-Jella-ppara	..	..	..	..	..	..	..	..	[illegible]	[illegible]	270.0	315.0	330.0	1342.00
	VIII-Kathiram-patty	..	..	..	..	..	..	..	..	..	..	342.0	350.0	311.00	003.00
	IX- Moolakom-bu	..	..	..	..	..	..	..	..	..	..	..	..	140.0	140.00
	otal-Agricultural land	259.00	241.00	87.00	605.00	470.00	624.00	726.21	690.78	839.0	1020.0	1365.66	1330.00	1153.00	9415.35
	Forest land	..	..	..	..	..	..	29.00	23.50	..	..	..	..	.	

3.6. The land use with treatment schedule for the four selected watersheds are given in Table 3.3. The details of area treated on each watershed and other construction works done are summarised and given below:

1.	Watershed No. I. Kuruthorai	(1) Area treated with contour terrace walls 1186 Hect. (2) Construction of checkdam type 1 - 2 Nos.
2.	" No. II. Thalayani	(1) Area treated with contour terrace wall - 971 Hect. (2) Check dam type I - 225 Nos.
3.	" No. III. Mully	(1) Area treated with contour terrace wall - 507 Hect. (2) Checkdam type II - 360 Nos.
4.	" No. IV - Paloor	(1) Area treated with contour terrace wal l - 775 Hect. (2) Checkdam type I. 7 Nos. II. 6 Nos. -do- A 9 Nos. -do- B 2 Nos. (3) Pereculation tank/ Silt detention tank. 1 No.

Chapter IV

IMPACT OF THE PROGRAMME ON AGRICULTURAL PRODUCTION

4.1. One of the objectives of the study was to assess the benefits accrued due to the implementation of the soil conservation scheme. The soil conservation programme under watershed principle was started in 1975-76. Four watersheds viz. the kuruthorai, Thalayani, Mully and Paloor wherein the schemes were completed had been selected for the study. 151 beneficiaries out of a total of 2677 beneficiaries from all the four watersheds were selected. 20 control plots (5 from each watershed) were also selected for comparative purposes.

A brief description of the four watersheds is given below:

1. Watershed No. I. Kuruthorai: This watershed falls in sub-catchment No. VII of the Kundha Project (Kerala Portion). Seruvani, the main tributory of Bhavani river flows through this watershed. The soil conservation scheme for the watershed was sanctioned

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during 1975-76 and the work was completed in 1981-82. The total area of the watershed is 1300 Hectares.

2. Watershed No. II. Thalayani: This watershed falls in the sub-catchment No. VII. This forms the right hand tributory of Seruvani river. The soil conservation scheme was sanctioned during 1975-76 and the work was completed in 1981-82. The total area of this watershed is 1200 Hectare.

3. Watershed No. IV. Mully: This watershed falls in the sub-catchment No. IV of the project area (Kerala Portion). The soil conservation work in this watershed was sanctioned in 1980-81 along with the scheme for Kulkkoor. The work was started in 1980-81 itself and completed in 1983-84. The total area of the watershed comprisas of an area of 2610 Hectares.

4. Watershed No. IV. Paloor: This watershed falls in the sub-catchment No. II of the project (Kerala Portion). The total area of the watershed is 1535 Hect. The soil conservation programme in this watershed commenced during 1981-82 and completed in 1985-86.

4.2. General description of the soil in the watersheds:

Soil in the four watersheds is derived from gravite genesis and loam soils which are mostly clay and silt clay. The colour of the soil vary from dark grey to black. Red coloured loam and latenite soils are commonly seen. The soil is fairly deep except at the ridge and high area. The distribution of area possessed (stratum-wise) by the beneficiaries is given below:

Table 4.1

Distribution of total beneficiaries according to area possessed in the selected watersheds

Area Possessed (Stratum)	Watersheds & No. of beneficiaries				
	Kuruthorai	Thalayani	Mulloor	Paloor	Total
Stratum I (less than 1 Hect.)	368 (41.16)	290 (40.96)	140 (33.82)	354 (53.56)	1152 (43.03)
Stratum II (1 hect. upto 3 Hect.)	458 (51.23)	383 (54.10)	242 (58.45)	293 (44.30)	1376 (51.40)
Stratum III (3 hect. upto 5 Hect.)	57 (6.38)	31 (4.38)	31 (7.49)	13 (1.97)	132 (14.93)
Stratum IV (5 hect. and above)	11 (1.23)	4 (0.56)	1 (0.24)	1 (0.15)	17 (0.64)
TOTAL	894 (100.00)	708 (100.00)	414 (100.00)	661 (100.00)	2677 (100.00)

(Figures in brackets are percentages)

TABLE 3.3

Landuse with Treatment Schedule

Watershed No. 1 - Kuruthorai

Sl. No.	Description of work	Treated during the years (Area Hectare).													
		1975-76		1976-77		1977-78		1978-79		1979-80		1980-81		1981-82	
		Physical	Financial	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Contour terrace wall	123	329476	166	496254	67	160836	325	958840	254	559067	251	712449	..	14025
2	Contour trenching with embarkment	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Check dam Type 1	..	..	..	..	..	..	..	..	..	..	2 Nos.	946	..	..
4	Vegetative measure (RM)	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	Affortstation measures	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	Farm Forestry	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	Installation of sediment station	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	Instalation of Rainguages	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	Perculation tank/ silt detention tank	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	123	329476	166	296254	67	160836	325	958840	254	559067	251 2Nos.	713395	..	14025

TABLE 3.3(Contd...)

Land Use with Treatment Schedule

Watershed No. II - Thalayani

Sl. No.	Description of work	1975-76		1976-77		1977-78		1978-79		1979-80		1980-81		1981-82		1982-83	
		Physical	Financial	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Contour terrace wall	136	341932	75	237096	20	69345	280	927143	216	671460	130	499144	101	145248	13	9378
2	Contour trenching with embarkment	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Check dam Type 1	..	..	..	..	..	..	..	..	2Nos.	..	..	..	187 Nos.	164047	36	37757
4	Vegetative measure	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	Afforstation measure	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	Farm Forestry	..	..	,,	..	..	..	..	..	..	..	..	..	..	..	..	..
7	Installation of sediment	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	Installation of Rain guages	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	Perculation tank/ silt detention tank	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Total	136	341932	75	237096	20	69345	280	927143	216 2 Nos.	671460	130	499144	101 187Nos.	309295	13	[illegible]

Water Shed No.IV-Mully

TABLE 3.3 (Contd...)

Land use with Treatment Schedule

Sl. No.	Description of work	Treated during the years(Area Hectare)							
		1980-81		1981-82		1982-83		1983-84	
		Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
1	2	3	4	5	6	7	8	9	10
1.	Controur terrace wall	75	338125	222	1129711	160	813254	50	98852
2.	Contour trenching with embarkment	..	..	..	..	..	..	..	..
3.	Cheek dam type A	..	..	..	..	126 Nos.	103692	234	231189
4.	Vegetative measure(RH)	..	..	..	..	..	..	..	..
5.	Afforstation measure	..	..	..	..	..	..	..	..
6.	Farm forestry	..	..	..	..	..	..	..	..
7.	Installation of sediment	..	..	..	..	..	..	..	..
8.	Installation of Rainguages	..	..	..	..	..	..	..	..
9.	Perculation tank/silt detention tank	..	..	..	..	..	..	..	..
	Total	75	338125	222	1129711	160 126 Nos.	916946	50 234 Nos.	330041

TABLE 3.3(contd....)

Watershed No.V-Paloor — Land use with treatment schedule

Sl. No.	Description of work	Treated during the year(Area Hect.)									
		1981-82		1982-83		1983-84		1984-85		1985-86	
		Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
1	2	3	4	5	6	7	8	9	10	11	12
1.	contour terrace wal	106	560832	174	926310	214	1130815	200	1069285	81	115224
2.	Contour trenching	..	..	..	..	..	..	..	..	..	..
3.	Cheek dams- Type I	..	..	2 Nos.	946	..	..	2 Nos.	906	3 Nos.	4771
	Type II	..	..	4 Nos.	1104	2 Nos.	1182	..	..	..	..
	Type A	..	..	..	..	..	..	9 Nos.	12753	..	..
	Type B	..	..	..	..	..	..	2 Nos.	3382	..	..
4.	Vegetative measure	..	..	..	..	..	..	..	..	..	..
5.	Afforstation	..	..	..	..	..	..	..	..	..	..
6.	Farm forestry	..	..	..	..	..	..	..	..	..	..
7.	Installation of sediment	..	..	..	..	..	..	..	..	..	..
8.	Installation of rain guages	..	..	..	..	..	..	..	..	..	..
9.	Slit detention tank	..	..	..	..	..	..	1 No.	3673	..	..
	Total	106	560832	174 6 Nos.	928360	214 2 Nos.	1131997	200 14Nos.	1089999	81 3 Nos.	119

Except for Paloor more than 50% of the beneficiaries is having land from 1 Hectare to 3 Hect. (44.32% of the beneficiaries of Paloor is in this group). In this watershed majority of the beneficiaries (53.56%) are having land less than 1 Hect. Only 17 beneficiaries among all the watersheds are having land above five hectares.

The distribution of 151 beneficiaries selected for detailed survey from various watersheds is given in Table 4.2

Table 4.2

Distribution of selected beneficiaries according to area possessed (Stratum-wise)

Stratum	Watersheds and No. of selected beneficiaries				
	Kuruthorai	Thalayani	Mully	Paloor	Total
1	2	3	4	5	6
I	14 (27.45)	15 (37.50)	6 (25.00)	18 (50.00)	53 (35.10)
II	23 (45.10)	20 (50.00)	14 (58.33)	13 (36.11)	70 (46.36)
III	9 (17.65)	4 (10.00)	3 (12.50)	4 (11.11)	20 (13.25)
IV	5 (9.80)	1 (2.50)	1 (1.17)	1 (2.78)	8 (5.29)
TOTAL	51 (100.00)	40 (100.00)	24 (100.00)	36 (100.00)	151 (100.00)

(Figures given in brackets are percentages)

It can be seen that 46.36% of the beneficiaries selected are in Stratum II, 35% in stratum I, 13% in Stratum III and 5% in Stratum IV.

Distribution of beneficiaries according to area possessed and by their principal occupation

TABLE 4.3

Watersheds and No. of beneficiaries

Stratum	Kuruthorai			Thalayani			Mully			Paloor			Total			Total
	A	NA	L	A	NA	L	A	NA	L	A	NA	L	A	NA	L	
I	3	1	10	3	1	11	1	2	3	11	4	3	18	8	27	53
II	12	3	8	11	-	9	3	2	9	9	4	-	35	9	26	70
III	8	1	-	3	-	1	3	-	-	4	-	-	18	1	1	20
IV	3	2	-	1	-	-	-	-	1	1	-	-	5	2	1	8
	26	7	18	18	1	21	7	4	13	25	8	3	76	20	55	151

A - Agriculture, NA - Non-Agriculture, L - Labourer

Contd...

It is found that in Kuruthorai watershed 51% of the selected beneficiaries are having agricultural occupation (cultivators) more than 35% are labourers and about 14% are having non-agricultural occupations.

In Thalayani watershed, 52.5% are labourers, 45% are cultivators and 2.5% are having non-agricultural occupations.

54% of the selected beneficiaries in Mully watershed area are labourers, 29% are cultivators and 17% are having non-agricultural occupations.

In Paloor watershed, 70% of the selected beneficiaries are cultivators, 8% are labourers and 22% are having non-agricultural occupations.

4.4. Result of the Survey: The survey was conducted by contacting the beneficiaries and visiting the plots. The area possessed by the selected beneficiaries for each stratum and the utilisation of the land before the implementation of the soil conservation programme and after the implementation of the programme during 1986-87 in each watershed are given in table 4.4.

In Mully watershed area, it is found that the areas not cultivated before and after the soil conservation programme remain the same. But in Kuruthorai, Thalayani and Paloor, more areas are left uncultivated after the soil conservation programme, in 1986-87. It shows that the soil conservation measures had no effect in increasing the area under cultivation. This may be attributed to the following reasons: (1) the cultivation in catchment area mainly depended upon rains and (2) due to drought more land was left fallow. Further, crops grown were damaged due to drought and pest attack. If proper irrigation facilities were provided, all the agricultural lands in the catchment area could have been brought under cultivation.

As already stated, the area cultivated before the soil conservation programme had been left fallow or uncultivated during 1986-87 after the implementation of soil conservation programme, due to drought and pest attack. The crops grown during 1987-88 were also damaged due to drought and pest attack. In these circukstances, there is no meaning in comparing the income derived from the beneficiary plots before and after the soil conservation programme. The expenditure, income and net income derived from the beneficiary plots during 1986-87 in each of the watershed are given in table 4.5.

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TABLE 4.5

Gross area cultivated, income, expenditure and net income from the beneficiary plots during 1986-87 by strata.

Stratum	No. of beneficiary plot	Gross area	Expenditure	Income	Net income
1	2	3	4	5	6
I. Watershed - Kuruthorai					
I	14	7.3629	16943	9125	
II	23	33.4551	68120	40070	
III	9	25.7000	43212	20200	
IV	5	17.5986	55460	39300	
Total	51	86.1166	183735	108695	(-) 75040
II. Watershed - Thalayani					
I	15	12.9834	24090	28345	-
II	20	32.5598	41162	46850	-
III	4	11.6000	24624	27350	-
IV	1	7.1000	7525	6400	-
Total	40	64.2432	97401	108945	(+) 11544
III. Watershed - Mully					
I	6	2.6840	2095	2600	-
II	14	15.4197	11644	9065	-
III	3	10.7000	8699	5800	-
IV	1	2.0000	1644	1200	-
Total	24	30.8037	24082	18665	(-) 5417
IV. Watershed - Paloor					
I	18	29.3220	29592	32460	-
II	13	24.0310	31757	33410	-
III	4	25.9165	54780	70800	-
IV	1	5.7240	6090	8800	-
Total	36	84.9935	122219	145470	(+) 23251

In Thalayani and Paloor watersheds some of the beneficiary cultivators had earned higher income. But most of the cultivators had incurred losses in seasonal and annual crops. This fall is attributed to drought and pest attack.

Contd....

TABLE 4.4(Land utilisation)

		Area Assessed	Before the soil conservation scheme				During 1986-87			
			Area cultivated	Other uses	Fallow	Not cultivated	Area cultivated	Other uses	Fallow	Not cultivated
		2	3	4	5	6	7	8	9	10
Kuruthurai	I	37.7850	7.2424	0.2069	..	30.3357	5.4841	0.2069	2.2080	29.8860
	II	46.5287	33.5685	1.4727	0.1264	11.3611	18.5951	0.1881	18.4842	9.2840
	III	34.9456	27.5687	1.0441	3.5515	2.7813	16.7500	1.4956	10.8187	5.8813
	IV	90.9560	23.9986	2.7560	5.0000	59.2014	16.1986	0.7560	7.8000	66.2014
	Total	210.2153	92.3782	5.4797	8.6779	103.6795	57.0278	2.6466	39.2882	111.2527
Thalayani										
	I	13.4823	10.4563	0.0520	2.1956	0.7784	7.0157	0.0520	2.7056	3.7090
	II	42.6511	33.4898	0.6321	1.6234	6.9058	25.5004	0.1321	7.9894	9.0292
	III	13.5452	13.5030	0.0422	Nil	Nil	9.2500	0.0421	4.2530	Nil
	IV	5.1051	5.1000	0.0051	Nil	Nil	5.1000	0.0051	Nil	Nil
	Total	74.7837	62.5491	0.7314	3.8190	7.6842	46.8661	0.2314	14.9480	12.7382

TABLE 4.4(contd....)

Soil Conservation Kundah Project (Kerala Portion)

Land Utilisationbefore and after S.C.Programme

Stratum	Area Possessed	Before S.C. Programme				During 1986-87			
		Area cultivated	Other use	Fallow	Not cultivated	Area cultivated	Other use	Fallow	Not cultivated
1	2	3	4	5	6	7	8	9	10
Mully									
I	11.0545	4.1581	0.0564	Nil	6.8400	2.1840	0.0564	1.9741	6.8400
II	23.7646	19.8914	0.6592	2.2140	1.0000	10.6197	0.6592	11.4857	1.0000
III	10.8703	10.7000	0.1703	Nil	Nil	8.7000	0.1703	2.0000	Nil
IV	5.2041	5.1500	0.0541	Nil	Nil	2.0000	0.0541	3.1500	Nil
Total	50.8933	39.8995	0.9400	2.2140	7.8400	23.5037	0.9400	18.6098	7.8400
Paloor									
I	32.7258	13.1911	0.2194	Nil	19.3155	11.0467	0.2194	1.3354	20.1243
II	27.8853	18.9582	0.9688	1.2500	6.6708	18.2712	0.3482	0.6587	8.6072
III	16.6140	14.9165	0.5815	Nil	1.1160	14.9165	0.6175	Nil	1.0800
IV	8.0000	5.7240	0.4000	Nil	1.8760	5.7240	0.4000	Nil	1.8760
Total	85.2251	52.7898	2.1697	1.2500	28.9783	49.9584	1.5851	1.9941	31.6875

Ragi, Jower, horsegram, pulses, blackgram, other millets, tur and ground nut are the common food crops grown in all the watersheds. No cash crops are seen grown in Mully area. Cotton was grown in Paloor. Pepper and coffee were grown in Thalayani. In Kuruthorai rubber, pepper and coffee were grown during the reference period.

Manures, fertilizers and pesticides were seen applied to cash crops and some of the annual crops like cotton. Majority of the cultivators had not applied any manure, fertilizer and pesticide to seasonal crops. If proper irrigation facilities were provided and the attack of pests was controlled the cultivation in these areas could have been made profitable.

"Pattikathu" is seen followed by some of the cultivators. This is a method of collecting of cowdung. Cattles are allowed to graze the land after harvest and the herd of cattle will be allowed to stay in the land itself. The cowdung will be collected and used for cultivation. This old practice is still prevalent among the cultivators in the area.

The details of crops grown in the beneficiary plots in the year 1987-88 were also collected. The gross area under cultivation along with expenditure, income and net income are given in table 4.6.

Table 4.6

Gross area under cultivation in the beneficiary plots during 87-88 and the expenditure/income

Stratum	Gross area (Hect.)	Expenditure (Rs.)	Income (Rs.)	Net Income (Rs.)
1	2	3	4	5
1. Watershed - Kuruthorai				
Stratum I	0.432	15200	13375	
II	1.820	64805	68705	
III	35.200	59000	58390	
IV	7.700	14395	14150	
TOTAL	[illegible]	153400	154620	+ 1130

Contd....

1	2	3	4	5
II. Watershed - Thalayani				
I	10.769	21005	17950	
II	39.967	54535	52725	
III	6.300	11695	11200	
IV	No crop due to drought			
TOTAL	57.036	87235	81875	(-) 5360
III. Watershed - Mully				
I	8.053	13255	10106	
II	15.869	19230	12700	
III	8.000	10605	7100	
IV	4.000	4000	4400	
TOTAL	35.922	47090	34306	(-)12784
IV. Watershed - Paloor:				
I	17.690	48405	31635	
II	18.500	46840	46730	
III	20.600	41285	41720	
IV	No crop due to drought			
TOTAL	56.790	136530	120085	(-)16445

It was found that the beneficiary plots in stratum IV in Paloor and Thalayani watersheds were not cultivated during 1987-88 due to drought. Some of the crops were damaged fully due to drought and pest attack. No appreciable change was seen on the crops grown during 1987-88.

4.5. Five control plots were selected from each of the watersheds.

The distribution of these cultivators according to the principle means of lively-hood and the area surveyed are given in table 4.7.

Table 4.7.

Distribution of cultivators of control plots and the area surveyed.

Watershed	Agricultural		Non-Agricultural		Other Rural Labourer	
	No.	Area (Ha.)	No.	Area (Ha.)	No.	Area (Ha.)
Kuruthorai	3	9.00	-	-	2	1.00
Thalayani	4	3.20	-	-	1	0.30
Mully	4	7.05	-	-	1	2.00
Paloor	3	4.75	-	-	2	2.75
Total	14	24.00	-	-	6	6.05

The Gross area cultivated during 1986-87 and the details of expenditure and income are given in table 4.8 below.

Table 4.8

Gross area cultivated in the control plots for 1986-87 and the expenditure/income

Watershed/ Stratum	Gross area 0.00 Ha.	Expenditure	Income	Net Income
1	2	3	4	5
I. Kuruthorai				
I	1.00	1460	1000	
II	2.75	4700	2000	
III	2.00	3390	2000	
Total	5.75	9550	5000	(-) 4500
II. Thalayani				
I	3.30	5600	4280	
II	1.00	1870	950	
Total	4.30	7470	5230	(-) 2240
III. Mully				
I	0.50	408	400	
II	2.23	1316	900	
III	9.00	3197	3000	
Total	11.73	4921	4300	(-) 621
IV. Paloor				
I	1.50	2400	2900	
II	8.10	11535	11470	
Total	9.60	13935	14370	(+) 385

It can be seen that except in Paloor the expenditure for cultivation was greater than the income received. As the crops grown in control plots were also damaged due to drought and pest attacks as in the case of beneficiary plots, there is no meaning in comparing the production figures from the beneficiary and control plots.

4.6. Maintenance of bunds: As per the programme, the maintenance of soil conservation works have to be done by the beneficiaries. Out of the 151 sample beneficiaries, only 3 have done

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maintenance of works and the reason for not doing the maintenance of works by others is attributed to lack of funds.

Damages were also seen in the works of contour bunds and check dams in the beneficiary plots. A description of work and extent of damage are given in table 4.9.

Table 4.9

The description of soil conservation works and the extend of damage caused

Stratum	Type of work	Description (Sl.metre)	Broken in parts (Sq.metre)	Percentage of damage
1	2	3	4	5
Kuruthorai				
I.	Contour bunds	4983.16	810	16.25
II.	"	21661.95	3205	14.79
III.	"	21447.00	2515	11.73
IV.	"	16224.20	1300	8.00
Total		64316.31	7830	12.17
Thalayani				
I.	Contour bund	8760.90	1675	19.12
II.	"	26631.19	4770	17.91
III.	"	7555.65	1250	16.54
IV.	"	5105.00	300	5.88
Total		48052.74	7995	16.64
Mully				
I.	Contour bund	3174.00	495	15.59
	Check dam	5 Nos.	3 Nos.	60
II.	Contour bund	17022.50	2870	16.86
	Check dam	12 Nos.	3 Nos.	25
III.	Contour bund	6928.00	1450	20.92
	Check dam	4 Nos.	2 Nos.	50
IV.	Check dam	11 Nos.	4 Nos.	36.36
Total	Contour bund	27124.50	4815	17.75
	Check dam	32 Nos.	12 Nos.	37.5
Paloor				
I.	Contour bund	10855.10	2090	19.25
II.	"	16867.39	3440	20.39
III.	"	10963.00	1800	16.42
IV.	"	4172.00	750	17.98
Total		42857.49	8080	18.85

The damage is the breaking of bunds in parts. If the broken parts are not repaired, the damage to the bund will increase and in course of time the entire bund will perish. It is the responsibility of the beneficiaries to maintain soil conservation work. There is no provision in the scheme to provide fund for maintenance. It may be suggested that the damages to bunds which will cause further damages are to be identified by the soil conservation Department on a follow up action and the cultivators may be persuaded to repair the broken parts in time.

32 check dams in Mully watershed were surveyed and it is found that 12 check dams were broken in parts. Breakage of check dam will be more serious them the partial damage to bunds. Therefore, the check dams have to be inspected and repairs done at any cost.

4.7. Effectiveness of Soil Conservation works: The opinions of the beneficiary cultivators about the effectivenss of soil conservation programmes were gathered. These are given in Table 4.10.

Table 4.10

The opinion of the beneficiaries about the effectiveness of Soil Conservation works

Watershed	Total No. of beneficiaries	No. of beneficiaries giving the opinion					
		Effectiveness of contour bunds		Fertility of soil		Mosture retention	
		Moderate	No effect	Moderate	No effect	Moderate	No effect
1	2	3	4	5	6	7	8
I. Kuruthorai	51	51	-	51	-	51	-
II. Thalayani	40	31	9	25	15	25	15
III. Mully	24	18	6	18	6	18	6
IV. Paloor	36	36	-	35	1	29	7
Total	151	136	15	129	22	123	28

Out of the 151 selected beneficiaries, 136 are of the opinion that the soil conservation work had moderately controlled soil erosion. The remaining 15 are of the opinion that the works had no effect. Regarding fertility of soil, 129 beneficiaries are of opinion that there was moderate improvement in the fertility of soil due to soil conservation works. The remaining 22 beneficiaries have not felt any visible improvement.

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123 beneficiaries are of opinion that moisture retention had been moderately increased due to soil conservation works. The remaining 28 beneficiaries are of opinion that there was no change in this respect.

4.8. Visit of Soil Conservation Staff: According to the sample beneficiaries, the soil conservation staff had visited their plots before and after the completion of the works.

4.9. Study on Check dams: In addition to the detailed survey of beneficiary plots from the four watersheds, the details of sample check dams constructed in Thalayani watershed were also collected. Out of the four samples, three check dams were constructed in 1981-82 and fourth one in 1982-83. The details collected on the check dams are given in Table 4.11.

Table 4.11. Details of check dams selected and the present condition -

Details	Samples			
	1	2	3	4
1	2	3	4	5
1. Physical feature				
	A1. 3 Nos.	5 Nos.	2Nos.	5 Nos.
	B1. 4 "	1 No.	2 Nos.	Nil
2. Nature of Construction	Stone packing without cement	Stone packing without Cement	Stone Packing without cement	Stone packing without cement
3. Prevention of water flow	Moderate	Moderate	No effect	No effect
4. Present condition of the work	All the 7 are broken in parts	Seriously damaged - 3 Broken inparts - 3.	Seriously damaged 4	Seriously damaged 3 and broken in parts 2
A1. Length 6M.	Width	1.4M	Height	1.5M
B1. Length 4.8 M.	"	1.2M	"	1.5M

Out of the 22 check dams of type A1 & B1 in the four samples, nine check dams are reported to be of no effect and others had only moderate effect. The condition of the check dams was poor. 10 check dams were seriously damaged and the remaining 12 were broken in parts. These check dams were constructed with stone packing

Contd....

without cement. It seems that if the check dams were constructed with stone packing with cement such damages might not have occured. Therefore, the soil conservation Department may review the mode of construction of check dams and consider the possibility of maintenance of the check dams.

4.10. Repayment of loan: The scheme envisages that 50% of cost of soil conservation work has to be repaid by the beneficiary cultivators. But the survey had shown that non of the beneficiaries - even the non-agriculturists - has not repaid the loan portion so far. It is not known whether any action has been initiated for loan recovery.

4.11. Agency for work: All soil conservation works have been executed by the nominees (Contractors) of the beneficiaries.

4.12 Impacts Soil Conservation Measure

The details of rainfall, run-off and sediment yield as recorded in the Silt Monitoring Stations, Karayoor, Kallakara, Kottamala, Kuttanadi, Paloor, Jellappara and Kavundickal watersheds are given in Appendix A1. The details of Silt load analysed in the above silt Monitoring stations are obtained from the Assistant Director, Engineering Hydrology, Kundha Project, Kottathara and are given in Appendix A2.

From the above statements, it can be seen that there was direct impact of the benefit of adopting various soil conservation measures in the watersheds - A final conclusion of the findings can be obtained only after the conduct of a detailed study of the silt load in the main stream of Bhavani and its outlets. The data evolved from such a study can be effectively co-related with data from individual watersheds for a more effective interpretation.

The Engineering Hydrology Division had started Farm Forestry Measures in 1986-87 by raising seedlings in their nursery. The division had raised one lakh of seedlings during 1986-87 out of which 25000 seedlings were distributed in the same year. The remaining 75000 seedlings were ready for distribution in 1987-88.

Contd....

Chapter V

Silt Evaluation:

The first priority catchment area of the Kundha project (Kerala Portion) according to Dr.S.V.Govindarajan, Chief Soil Survey Officer, Government of India works to 4,575 Hect. These area comprises mostly of Agricultural lands under cultivation of various crops. As already stated the soil conservation work in the first priority area was commenced from 1967-68 and was completed during 1974-75, by covering a total area of 3,709 Hect. On completing the soil conservation work in the first priority area the soil erosion in those areas would have been prevented.

Earlier, the silt evaluation work was done in Seruvani and Verager rivers. This was later discontinued. It is reported that the Tamilnadu Government by the end of 1972 have diverted the Veragar river to Tamilnadu and since then, there was practically little flow of water in the Kerala portion.

As there is no silt load analysis at present, in the main stream of the two rivers by the soil conservation unit the effect of soil conservation work in the first priority area could not be ascertained.

Sediment monitoring in the priority watersheds is being attended to at present. The sediment monitoring stations in the priority watersheds have been commenced functioning during 1978-79 and the recording of discharge was started from February 1981. Rain gauge stations have also been started in these watersheds except at Kathirampathy.

The S.M. stations are under the control of the Assistant Director, Engineering Hydrology, Kottathara. The following S.M.stations have been started functioning during the years noted against each in the respective watersheds.

Watershed	S.M.Station	Year of recording started
Kuruthorai	Kallakkara	1981
-do-	Karayoor	1981
Thalayani	Kottamala	1981
Thalayani	Kuthanady	1981
Paloor	Paloor	1984

Contd...

Jelleppara	Goolikandan	1985
Jelleppara	Jelleppara	1985
Kavundickal	Narassimukku	1986
Kathirampathy	Palliyara	1987

Method of analysis

Rectangular weirs are constructed in the main stream of the watersheds. The water collected in the weirs is taken and analysed scientifically.

Usually, a water sample of 100 ml. is taken and on drying the exact quantity of silt load is found out.

The S.M. stations are not seen constructed in the watersheds before the commencement of the soil conservation programme. The run off data in a watershed before the commencement of the soil conservation programme is also not available. The data are available only after the commencement of the soil conservation programme and only when the silt monitoring stations in that watershed started functioning. There is a proposal in the watershed management programme for 1988-89 to discontinue the silt monitoring stations at Kuttanady, Kottamala and Paloor from which data have been collected and compiled for the last five years. It can therefore be seen that the life of a S.M.station in a watershed is five years.

CHAPTER VI

Summary and Concluding Observation

1. This Evaluation study envisages (i) to review the progress of implementation of Soil Conservation Programmes in the catchment area of Kundha Project (Kerala portion) and (ii) to access the benefits accrued due to the implementation of the scheme with special emphasis on the impact in the rate of silting in the area.

2. According to the norms of Government of India, there should have been concurrent evaluation of the programme. On the request of the Agriculture Department the SPB (State Planning Board) had initiated an evaluation study by the end of 1970. Six rounds of studies were conducted by the SPB. till 1976-77. Further studies were not taken up by the SPB. On the strength of a discussion by the Department of Economics and Statistics with Soil Conservation Department in June 1983, it was decided to take up the evaluation study again by the Department of Economics and Statistics.

3. Kundha Project is one among the 14 major Hydro Electric Projects in the country where Soil Conservation works have been initiated. This project comprises of a total area of 1259.91 Sq.Km. (125991 Hect.) of which 569.80 Sq.Km. (56980 Hect.) are in Kerala and the rest is in Tamil Nadu.

4. A survey was conducted in four water sheds viz Kuruthorai Thalayani, Mully and Paloor. The reference period was 1976-77 Agricultural year. 151 beneficiaries in the four water-sheds were selected for a detailed survey. Five control plots from each water shed were also selected for detailed study.

5. The scheme was implemented with 100% Central assistance comprising of 50% grant and 50% loan. The work is to be undertaken by the cultivators in actual possession of land or through their nominees under the technical control and supervision of the S.C. Department. The beneficiary cultivators have to execute an agreement to repay 50% of the total expenditure of the work in 20 half yearly equal instalments with 6% interest within a period of 10 years. The survey shows that the Soil Conservation works were executed by the nominees (contractors). It is also evident that none of the beneficiaries has repaid any amount. It is not known whether steps have been taken for the recovery of the loan. In this context, the desirability of exempting the

hill tribes possessing less than one hectare of land in the project area from the repayment of loan may be considered and this expenditure may be treated as a special grant to the scheduled tribes. This will make the scheme result oriented and the scheduled tribes achievement conscious.

6. During the years 1975-76 to 1977-78, a total area of 9416 ha. of agricultural lands were treated at a total cost of Rs.434 lakhs. Here the per Hectare cost worksout to be Rs.4609/-. The expenditure on establishment excluding the expenditure of the Headquarters staff at Trivandrum was Rs.117 lakhs of which Rs.43 lakhs were under non-plan and the rest of Rs.74 lakhs were under plan. The establishment charges were found to be 27% of the expenditure on works. The average cost already fixed in the general guidelines issued by the Government of India, was (1) overall cost including establishment and other charges Rs.500/-ha. and (2) establishment (pay and allowances) of the regular staff to be 20% of the total cost. The higher rate may be due to increase in cost of works and the increase in the pay and allowances of the staff. It was found that a total area of 13125 hectares of land were treated at a cost of Rs.480 lakhs in the whole catchment area of Kundha project (Kerala Portion) till 1987-88. The afforestation work done was only in 51 hectares and the expenditure incurred was Rs.3.46 lakhs. The per hectare cost of afforestation work was found to be Rs.6595/- against Rs.200/- fixed by the Government of India in the general guidelines.

7. It was found that the area not cultivated before and after the Soil Conservation programme remains the same in Mully area but in the other three water sheds, the formerly cultivated areas were left barren. This shows that the soil conservation programmes in these areas failed to achieve the desired goal of increasing the area under cultivation. The cultivators were not in the habit of using manures, fertilizers and pesticides for the seasonal crops. The crops grown in 1986-87 and in 1987-88 were damaged due to drought and pest attack. Due to these, the crops failed in these areas. If proper irrigation facilities were provided in the agricultural lands in these areas, the losses due to drought could have been avoided. This with timely pest control measures would have yielded bumper crop in the catchment areas.

8. The Soil Conservation measures were mainly intended for preventing soil erosion. Contour bunds, check dams and gully plugging etc. are done for this purpose.

9. No serious damage was seen to soil conservation works in the beneficiary plots. But breakages of the contour bunds were noticed. There were no annual maintenances to these bunds. The reason for not maintaining the bund is attributed to lack of funds. There is no provision in the scheme for maintenance of bunds. In this direction, it may be suggested that the damages to the bunds may be identified by the Soil Conservation Department and follow up action may be initiated by them in the proper time.

10. 32 check dams in Mully water shed area were surveyed. It was found that 12 check dams out of these were broken in parts. The cultivators may be persuaded to repair the broken parts. Breakagesof check dams were more serious than partial damage to bunds. Actions have to be initiated for the inspection and repair of check dams.

11. Out of 151 beneficiaries selected, 136 were of opinion that the Soil Conservation works have moderately controlled soil erosion. For the remaining 15, the work had no effect. 129 beneficiaries were of opinion that there were moderate improvements in the fertility of soil. For the remaining 22 beneficiaries, the work had no effect. Regarding retention of moisture, 123 beneficiaries were of the opinion that there was moderate increase and for 28 beneficiaries, there was no change.

12. A detailed study was also conducted on the check dams constructed in Thalayani water shed. Out of the 22 check dams of type A1 and B1, in all the four selected samples, 9 check dams were reported to be of no effect and others have moderate effect. The present condition of the check dams is also poor. All the check dams were constructed with stone packing without cement. 10 check dams were found to be seriously damaged and the remaining 12 are broken in parts. If the check dams were constructed with stone packing with cement such severe damages would not have been occurred. The nature of construction of the check dams is to be reviewed by the Soil Conservation Department and action taken to improve the construction of the check dams.

13. Sediment monitoring stations are not seen constructed in the water sheds before the commencement of the soil conservation programme. The stations are seen constructed during the course of the programme and as such the data on silt load before the commencement of the programme in the water sheds are not available. It is seen that the life of a Silt Monitoring Station is only for five years. There is no silt monitoring station in the main stream of Bhavani river and in its outlets. The run off data recorded in Seruvani river at Kottathara in 1980 is seen to have been taken as an index for silt load in the schemes proposed for the water shed management programme. This shows that after 1980, no silt load analysis was done in the main stream of the rivers or in their outlets. From the statements on sediment yield, it can be seen that there is direct benefit of various soil conservation measures in the water sheds. But a final conclusion of the findings can be obtained only after a detailed study on the silt load in the main stream of Bhavani river and in its outlets. The data evolved from such a study can be effectively be correlated to the data from individual water sheds for a more effective interpretation.

14. The Engineering Hydrology division has started Farm Forestry measures in 1986-87 by raising seedlings in their nursery. One lakh seedlings have been raised during 1986-87 of which 25000 were distributed. The Social Forestry Division of the Forest Department is not seem to have extended their work in the catchment areas. The private forests have been denuded. There is much scope for Social Forestry Division in the catchment areas towards Soil Conservation measures.

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APPENDIX A1

Monthly Rainfall, Runoff, and Sediment yield Data S.M. Station - Karavoor

Month Year		January	February	March	April	May	June	July	August	September	October	November	December	Total
1981	P	-	-	-	93	74.5	506.5	353	278.5	343.5	338.1	130	-	1900.1
	Q	-	-	-	68.108	25.534	64	37.64	8.579	10.877	109.259	42.32	-	366.371
	S	-	-	-	6.625	3.142	3.428	1.81	0.28	0.311	8.54	2.45	-	26.592
1982	P	-	-	-	80.7	175.9	132	137.7	135.1	59.3	34.4	262	-	1017.1
	Q	-	-	-	13.406	170.288	56.84	166.698	118.383	63.324	39.159	117.59	-	745.738
40	S	-	-	-	1.2	3.25	2.18	2.183	1.51	6.9	3.8	8.3	-	29.326
1983	P	-	-	-	-	69.6	141.3	63.4	82	81	82	-	-	519.3
	Q	-	-	-	-	23.235	23.845	16.83	4.842	17.26	29.138	-	-	115.15
	S	-	-	-	-	2.98	2.64	1.09	0.29	1.0	2.68	-	-	10.68
1984	P	-	-	-	-	-	134	-	-	-	-	-	-	134
	Q	-	-	-	-	-	20.469	-	-	-	-	-	-	20.469
	S	-	-	-	-	-	5.97	-	-	-	-	-	-	5.97

jr/ P - Rainfall in mm. Q - Run off hm. S - Sediment production Station/100 Sq.km.

Appendix A1

Monthly Rainfall (P .mm) Run off (Q.hm.) and sediment yield (H.M.)/100 km^2/DATA
S.M.Station Kottamala

		Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	P	-	-	-	-	-	258	278.5	343.5	338.1	130	-	1348.1
1981	Q	-	-	-	-	-	54.036	33.0147	33.1370	244.6	138.815	-	503.603
	S	-	-	-	-	-	0.7854	1.0101	0.4487	5.086	3.103	-	7.592
	P	-	-	-	80.7	175.9	132	137.7	135.1	59.3	84.4	-	1004.1
1982	Q	-	-	-	38.735	112.8032	156.536	214.92	175.782	90.52	83.28	-	1216.3007
	S	-	-	-	1.066	0.7289	5.7434	6.91	6.0	2.655	2.200	-	25.445
	P	-	-	-	-	69.6	141.3	63.4	82	81	82	23	- 541.3
1983	Q	-	-	-	-	67.223	0.7289	55.385	23.370	50.301	61.547	22.078	-- 340.204
	S	-	-	-	-	2.346	1.0848	0.92	0.388	0.936	1.013	0.21	- 7.5185
	P	-	-	-	-	50.6	134	43	41.5	82	196	219.4	15 731.5
1984	Q	-	-	-	-	48.3516	75.300	62.67	24.405	56.403	78.7400	71.627	34.741 452.704
	S	-	-	-	-	0.6239	0.95	0.7719	0.288	0.676	0.977	0.848	0.4 5.5348
	P	24	12	-	-	16.5	21	47.5	-	45	30	69	18 203
1985	Q	46.065	14.323	-	-	50.25	33.566	15.9779	-	17.94	17.3	22.38	19.293 237.095
	S	0.531	1.636	-	-	0.655	0.3938	0.182	-	2.104	0.205	0.2659	0.2849 6.193
	P	-	22	-	23	21	21	18	-	46	80	33	20 284
1986	Q	-	10.4452	-	7.2651	7.8861	11.7932	3.2512	-	7.9067	23.04	6.298	4.3259 82.21
	S	-	0.1178	-	0.0839	0.087	1.3032	0.034	-	0.078	0.234	0.642	0.045 2.644
	P	-	12	46	-	67	-	-	23	43	446	209	468 1314
1987	Q	-	2.353	7.5913	-	5.9400	-	-	1.9923	8.29	47.749	75.1956	50.432 199.523
	S	-	0.248	0.08	-	0.627	-	-	0.0206	0.088	0.5358	0.906	0.6379 3.143

jr/

APPENDIX A1

Monthly Rainfall (R.mm)Runoff (2 hm) and Sediment yield (S-hm/100 Km^2 D DATA
SM . Station - Kuthanady

Month Year		January	February	March	April	May	June	July	August	September	October	November	December	Total
1981	P							253	278.5	343.5	338.1	130	-	1343.10
	Q	-	-	-	-	-	-	132.83	72.708	116.612	513.41	246.45	-	1082.01
	S							3.3	3.22	1.95	1368	6.40	-	22.214
1982	P				80.7	175.9	132	137.7	135.1	59.3	84.4	262	-	1067.10
	Q	-	-	-	67.9	565.06	327.52	480.76	390.181	183.29	164.936	480.93	-	2660.57
	S				2.325	22.99	14.458	19.29	15.95	6.99	5.116	16.308	-	103.427
1983	P	-	-	-	-	69.6	141.3	63.4	82	81	82	23	-	542.30
	Q					155.08	129.465	112.46	44.66	110.97	134.018	65.082		751.735
	S					6.632	3.35	1.716	0.818	1.99	2.69	0.83		18.026
1984	P					50.6	134	43	41.5	82	196	219.4	15	781.50
	Q	-	-	-	-	86.255	192.686	134.7	58.234	139.63	210.372	187.93	86.392	1096.193
	S					1.3	3.0124	2.025	8.416	2.133	3.208	2.667	1.241	24.002
1985	P	24	12	-	-	16.5	21.0	47.5	-	45	30	69	18	283
	Q	85.018	26.59	-	-	86.5	82.14	36.59	-	49.079	54.3	70.55	36.724	527.492
	S	1.216	0.375	-	-	1.308	1.15	0.508	-	0.6833	0.773	0.993	0.514	7.52
1986	P	-	22	-	23	21	21	18	-	46	0	33	20	284
	Q	-	22.299	-	13.455	16.866	32.75	6.318	-	18.21	57.41	18.511	8.748	194.56
	S	-	0.308	-	0.189	0.216	0.433	0.083	-	0.225	0.733	0.191	0.134	2.51
1987	P	-	12	46	67	67	-	-	23	43	446	209	468	1314
	Q	-	5.727	20.379	-	17.28	-	-	4.819	20.233	108.689	154.131	98	429
	S	-	0.733	0.264	-	0.222	-	-	0.058	0.263	1.475	2.247	1.513	6

jr/

Appendix A1

Monthly rainfall, Runoff and sediment yield Data S.M. Station - Paloor

Month Year		Janu-ary	Febru-ary	March	April	May	June	July	Austust	Septem-ber	Octo-ber	Novem-	Decem-ber	To-tal
1984	P	-	-	-	-	-	-	-	-	-	318	104	65	577
	Q	-	-	-	-	-	-	-	-	-	56.64	41.51	19.406	
	S	-	-	-	-	-	-	-	-	-	1.488	1.029	0.452	117.566
1985	P	34	10	-	-	24	32	60	-	70	42	95	36	403
	Q	26.348	7.381	-	-	41.51	17.961	15.872	-	22.169	22.169	42.31	12.63	192.181
	S	0.6136	0.169	-	-	1.029	0.4364	0.383	-	0.536	0.5361	1.029	0.4488	4.7746
1986	P	-	7	-	9	11	17	12	8	21	40	20	8	153
	Q	-	10.917	-	6.896	8.6589	14.39	5.783	5.78	11.507	40.812	12.73	5.228	122.78
	S	-	0.2625	-	0.1667	2.08	0.345	0.138	0.1368	0.195	0.734	0.229	0.133	4.4205
1987	P	-	9	33	-	40	-	-	11	23	342	168	471	1097
	Q	-	4.635	12.73	-	7.745	-	-	2875	9.801	49.70	91.77	69.352	268.608
	S	-	0.083	0.0029	-	0.138	-	-	0.5	0.175	0.925	1.814	1.806	5.464

jr/

APPENDIX A1

Monthly Rainfall, Runoff and Sediment yield Data-S.M.Station Jellippara

Month / Year		January	February	March	April	May	June	July	August	September	October	November	December	
1985	P	-	-	-	-	-	153	61	-	109	71	173	57	486.5
	Q	-	-	-	-	-	55.309	37.58	-	27.97	35.67	54.001	23.42	233.959
	S	-	-	-	-	-	1.376	0.925	-	0.688	0.88	1.339	0.58	5.788
1986	P	-	22	-	-	21	21	-	17	46	80	33	20	260
	Q	-	10.3769	-	-	13.2662	23.024	-	7.213	11.45	46.87	18.725	6.598	137.523
	S	-	0.257	-	-	0.3285	0.567	-	0.177	0.1889	0.758	0.307	0.149	2.732
1987	P	-	12	46	-	67	-	-	23	63	466	-	-	657
	Q	-	5.5275	13.77	-	14.58	-	-	5.527	13.937	17.05	-	-	70.39
	S	-	0.09	0.225	-	0.236	-	-	0.089	0.225	0.278	-	-	1.143

jr/

APPENDIX A1

Monthly Rainfall (P-mm) Runoff (Q hm) and Sediment yield S hm /100 km^2 DATA
S.M. Station - Kavundachal

Month Year		January	Feb.	March	April	May	June	July	August	September	October	November	December	
	P	-	-	-	-	23	22	19	10	16	47	14	8	159
1986	Q	-	-	-	-	4.47	10.131	3.44	4.5458	7.885	17.466	5.462	1.696	55.09
	S	-	-	-	-	0.103	0.203	0.067	0.088	0.1536	0.338	0.104	0.03	1.08
	P	-	10	41	-	49	-	-	-	28	368	213	472	1181
1987	Q	-	2.473	9.3913	-	7.4196	-	-	-	7.4424	36.3818	71.78	56.1989	193.097
	S	-	0.0455	0.173	-	0.134	-	-	-	0.135	0.715	1.38	1.099	3.6815

jr/

Monthly Rainfall, Runoff land Sediment Yield Data S.M. Station,
Kallakkara

Month Year	January	Febru-ary	March	April	May	June	July	August	September	October	November	December	Total
1981 P	-	-	-	93	74.5	506.5	253	278.5	343.5	338.1	130	-	2017.1
Q	-	-	-	120.73	138.38	118.396	40.217	13.84	13.84	182.83	116.57	-	742.75
S	-	-	-	7.98	4.712	3.22	1.62	1.62	0.17	5.71	4.6	-	28.632
1982 P	-	-	-	80.7	175.9	132	137.7	135.1	59.3	84.4	262	-	1059.1
Q	-	-	-	35.798	219.071	115.892	226.29	149.006	60.66	72.912	228.43	-	1107.87
S	-	-	-	1.18	15.1	6.8	11.2	7.45	2.56	2.58	8.7	-	55.57
1983 P	-	-	-	-	162.6	141.3	63.4	82	31	82	-	-	519.3
Q	-	-	-	-	62.707	58.94	49.63	21.59	53.59	65.43	-	-	311.88
S	-	-	-	-	3.5	2.19	1.21	0.515	2.49	1.63	-	-	11.53
1984P	-	-	-	-	-	134	43	-	82	-	-	-	259.00
Q	-	-	-	-	-	65.327	29.901	-	56.822	-	-	-	152.05
S	-	-	-	-	-	0.6	0.138	-	5.31	-	-	-	6.048

jr/

APPENDIX A2

Table I

Sediment Monitoring Station: Kottamala
Catchment Area: No.II

Year of starting: 1981
Name of water shed: Thalayani

Month	1981		1982		1983		1984		1985		1986		1987	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	-	-	-	-	-	-	46.065	0.231	-	-	-	-
February	-	-	-	-	-	-	-	-	14.323	1.638	10.445	0.1178	2.353	0.24
March	-	-	-	-	-	-	-	-	-	-	-	-	7.5913	0.0
April	-	-	38.755	1.033	-	-	-	-	-	-	7.265	0.0839	-	-
May	-	-	212.886	6.728	67.123	2.346	48.35	0.6239	50.25	0.655	7.886	0.087	5.94	0.627
June	-	-	156.536	5.743	60.725	1.6648	75.698	0.95	33.566	0.3938	11.793	1.303	-	-
July	54.036	0.7354	214.92	6.91	55.345	0.93	62.67	0.7719	15.977	0.182	3.251	0.034	-	-
August	33.0143	1.01	175.791	6.00	23.376	0.355	24.465	0.288	-	-	-	-	8.97	0.020
September	33.137B	0.448	80.52	2.655	58.01	0.996	56.403	0.676	17.94	2.104	7.906	0.078	98.29	0.088
October	244.0	5.08	83.28	2.209	61.547	1.016	78.7466	0.977	17.3	0.205	23.04	0.634	47.749	0.535
November	138.815	3.103	253.62	1.17	22.038	0.21	71.627	0.848	22.38	0.2609	6.298	0.662	75.196	0.90
December	-	-	-	-	-	-	34.741	0.40	19.293	0.224	4.3259	0.045	50.432	0.63

Dis. - discharge (H.M.) S.L. - Silt load (H.M/100 km^2

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KUNDAH PROJECT

Table I

Sediment Monitoring Station: KUTHANDY — Year of starting: 1981

Catchment Area: No.II — Name of water shed: THALAYANI

Month	Year													
	1981		1982		1983		1984		1985		1986		1987	
	Dis	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	-	-	-	-	-	-	85.018	1.216	-	-	-	-
February	-	-	-	-	-	-	-	-	26.59	0.375	22.299	0.308	5.727	0.733
March			-	-	-	-	-	-	-	-	-	-	20.379	0.264
April			67.9	2.325	-	-	-	-	-	-	13.455	0.189	-	-
May			565.06	22.99	155.08	6.632	86.255	1.3	86.5	1.308	16.866	0.216	17.28	0.222
June			327.52	14.458	129.465	3.35	192.686	3.0125	82.14	1.15	32.75	0.433	-	-
July	132.83	3.3	480.76	19.29	112.46	1.716	134.7	2.025	36.59	0.508	6.38	0.083	-	-
August	72.708	3.22	390.181	15.95	44.66	0.818	58.234	8.416	-	-	-	-	4.819	0.058
September	116.612	1.95	183.29	6.99	110.97	1.99	139.69	2.133	49.079	0.6833	18.21	0.225	20.233	0.263
October	513.41	1.368	164.936	5.116	134.018	2.69	210.372	2.208	54.3	0.773	57.41	0.733	108.689	1.475
November	246.45	6.4	480.93	16.3[illegible]	65.082	0.83	187.93	2.667	70.55	0.993	18.511	0.191	154.131	2.247
December	-	-	-	-	-	-	86.392	1.241	36.725	0.514	8.748	0.134	98.0	1.513

Dis - discharge (H.M) S.L. - Silt load (H.M)/100 Km^2

jr/

Table I

KUNDAH PROJECT

Sediment Monitoring Station: KARAYOOR — Year of starting: 1981

Catchment Area: No.I — Name of water shed: KURUTHURAI

Month	Year													
	1981		1982		1983		1984		19		19		19	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	63.108	6.625	13.406	1.2	-	-	-	-	-	-	-	-	-	-
May	25.534	3.142	170.288	3.25	23.235	2.98	-	-	-	-	-	-	-	-
June	64	3.428	56.84	2.18	23.845	2.64	20.469	5.97	-	-	-	-	-	-
July	37.64	1.81	166.698	2.183	16.83	1.09	-	-	-	-	-	-	-	-
August	8.579	0.28	118.383	1.51	4.842	0.29	-	-	-	-	-	-	-	-
September.	10.877	0.311	63.324	6.9	17.26	1.0	-	-	-	-	-	-	-	-
October	109.259	8.54	39.159	3.8	29.138	2.68	-	-	-	-	-	-	-	-
November	42.32	2.45	117.59	8.3	-	-	-	-	-	-	-	-	-	-
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Dis. discharge (H.M) S.L. Silt load (H.M./100 km^2

jr/

Table: I

KUNDAH PROJECT

Sediment Monitoring: Kallakkara
Catchment Area: No.I

Year of starting: 1981
Name of water shed: Kuruthurai

Month	Year													
	1981		1982		1983		1984		19		19		19	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	120.73	6.98	35.798	1.18	-	-	-	-	-	-	-	-	-	-
May	138.38	4.712	219.071	15.1	62.707	3.5	-	-	-	-	-	-	-	-
June	118.396	3.22	115.872	6.8	58.94	2.19	65.327	0.6	-	-	-	-	-	-
July	40.217	1.62	226.27	11.2	49.63	1.21	29.901	0.138	-	-	-	-	-	-
August	11.84	1.62	149.006	7.45	21.59	0.515	-	-	-	-	-	-	-	-
September	13.84	0.17	60.56	2.56	53.59	2.49	56.822	5.31	-	-	-	-	-	-
October	182.83	5.71	72.912	2.58	65.43	1.63	-	-	-	-	-	-	-	-
November	116.57	4.6	228.43	8.7	-	-	-	-	-	-	-	-	-	-
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Dis. - discharge H.M. S.L. - Silt load H.M/100 km^2

jr/

KUNDAH PROJECT

Table: I

Sediment Monitoring station: Jellippara — Year of starting: 1985

Catchment Area: No.VII A — Name of water shed: Jellippar

Month	Year 1985		1986		1987		19		19		19		19	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	10.377	0.257	5.5275	0.09	-	-	-	-	-	-	-	-
March	-	-	-	-	13.77	0.225	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	13.266	0.328	14.58	0.236	-	-	-	-	-	-	-	-
June	55.309	1.376	23.024	0.567	-	-	-	-	-	-	-	-	-	-
July	37.580	0.925	-	-	-	-	-	-	-	-	-	-	-	-
August	-	-	7.213	0.177	5.527	0.089	-	-	-	-	-	-	-	-
September	27.97	0.688	11.45	0.1889	13.937	0.225	-	-	-	-	-	-	-	-
October	35.67	0.38	46.87	0.758	17.05	0.278	-	-	-	-	-	-	-	-
November	54.001	1.339	18.725	0.307	-	-	-	-	-	-	-	-	-	-
December	23.42	0.58	6.598	0.149	-	-	-	-	-	-	-	-	-	-

Dis. - discharge H.M S.L. - Silt load H.M./100 km^2

KUNDAH PROJECT

Table: I

Sediment Monitoring Station: Kavundikal (Narasimukku)
Catchment Area: No.VIII

Year of starting: 1986
Name of water shed: Kavundikal

Month	Year 1986		1987		19		19		19		19		19	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	2.473	0.0455	-	-	-	-	-	-	-	-	-	-
March	-	-	9.3913	0.173	-	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	4.47	0.103	7.4196	0.134	-	-	-	-	-	-	-	-	-	-
June	10.131	0.203	-	-	-	-	-	-	-	-	-	-	-	-
July	3.44	0.067	-	-	-	-	-	-	-	-	-	-	-	-
August	4.5458	0.088	-	-	-	-	-	-	-	-	-	-	-	-
September	7.885	0.1536	7.44	0.135	-	-	-	-	-	-	-	-	-	-
October	17.466	0.3318	38.38	0.715	-	-	-	-	-	-	-	-	-	-
November	5.462	0.104	71.78	1.38	-	-	-	-	-	-	-	-	-	-
December	1.696	0.03	56.1989	1.099	-	-	-	-	-	-	-	-	-	-

Dis. - discharge H.M. S.L. Silt land H. M/100 Km^2

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Table I

KUNDAH PROJECT

Sediment Monitoring Station: PALOOR
Catchment Area: No.VII

Year of starting: 1984
Name of water shed: PALOOR

Month	Year													
	1984		1985		1986		1987		19		19		19	
	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.	Dis.	S.L.
January	-	-	26.348	0.6136	-	-	-	-	-	-	-	-	-	-
February	-	-	7.38	0.169	10.907	0.2625	4.635	0.083	-	-	-	-	-	-
March	-	-	-	-	-	-	12.73	0.0229	-	-	-	-	-	-
April	-	-	-	-	6.896	0.1667	-	-	-	-	-	-	-	-
May	-	-	41.51	1.029	8.6589	2.08	7.745	0.138	-	-	-	-	-	-
June	-	-	17.96	0.4364	14.39	0.345	-	-	-	-	-	-	-	-
July	-	-	15.872	0.383	5.783	0.138	-	-	-	-	-	-	-	-
August	-	-	-	-	5.78	0.1368	2.875	0.50	-	-	-	-	-	-
September	-	-	22.169	0.536	11.587	0.195	9.801	0.1750	-	-	-	-	-	-
October	56.64	1.488	22.17	0.5361	40.812	0.734	49.70	0.925	-	-	-	-	-	-
November	41.51	1.029	42.31	1.029	12.73	0.229	91.77	1.814	-	-	-	-	-	-
December	19.406	0.452	18.63	0.4489	5.228	0.133	89.352	1.806	-	-	-	-	-	-

Dis. discharge H.M. S.L.Silt load H.M/100 km^2

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