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CHEMICAL AND SUSPENDED SEDIMENT CHARACTERISTICS OF TAWA RIVER DURING LOW FLOWS

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SYNOPSIS

Samples of water and particulate matter were collected during Dec.1986 at various locations of Tawa River (M.P.). On the basis of observation, chemical and sediment load supplied at various parts of the basin have been computed and compared to major rivers of India. Preliminary studies using X-ray diffraction have been made on the suspended sediments to ascertain the nature of particulate input of the Tawa reservoir.

1.0 INTRODUCTION

The phenomena of rivers discharging into reservoir, estuaries are of interest to a waide variety of scientists and engineers for many reasons. The chemical and sediment load, that are discharged by rivers into reservoir & estuaries, transport pollutants are the natural material that fill channel, reservoir harbors.

Studies on chemical and suspended sediment of river basins have received wide attention in the last two decades with a view to understanding the nature of material transported by rivers into estuaries reservoirs etc.

Tawa Catchment - River Tawa is a tributary of Narmada river rises from Satpura range of hills at an elevation of RL 2500. Denwa river is biggest tributary of Tawa. Tawa irrigation project constructed across the Tawa River. The general terrain is more or less plain with a gentle slope from SE to NW. The climate is temperate. The catchment area of Tawa river is 5982.90 sq.km. Basin falls under South West monsoon, which normally is confined to the period from middle of June to late September. The annual rainfall in the basin average to about 1646.13 mm (60.97 inches). About 90 percent of the rainfall during monsoon, when major flood occur.

The volume of flow during the monsoon averages to about 90 percent of the annual flow 1.9 MAF. Very little discharge during remaining part of the year 10% (0.19 MAF). It has been obser-

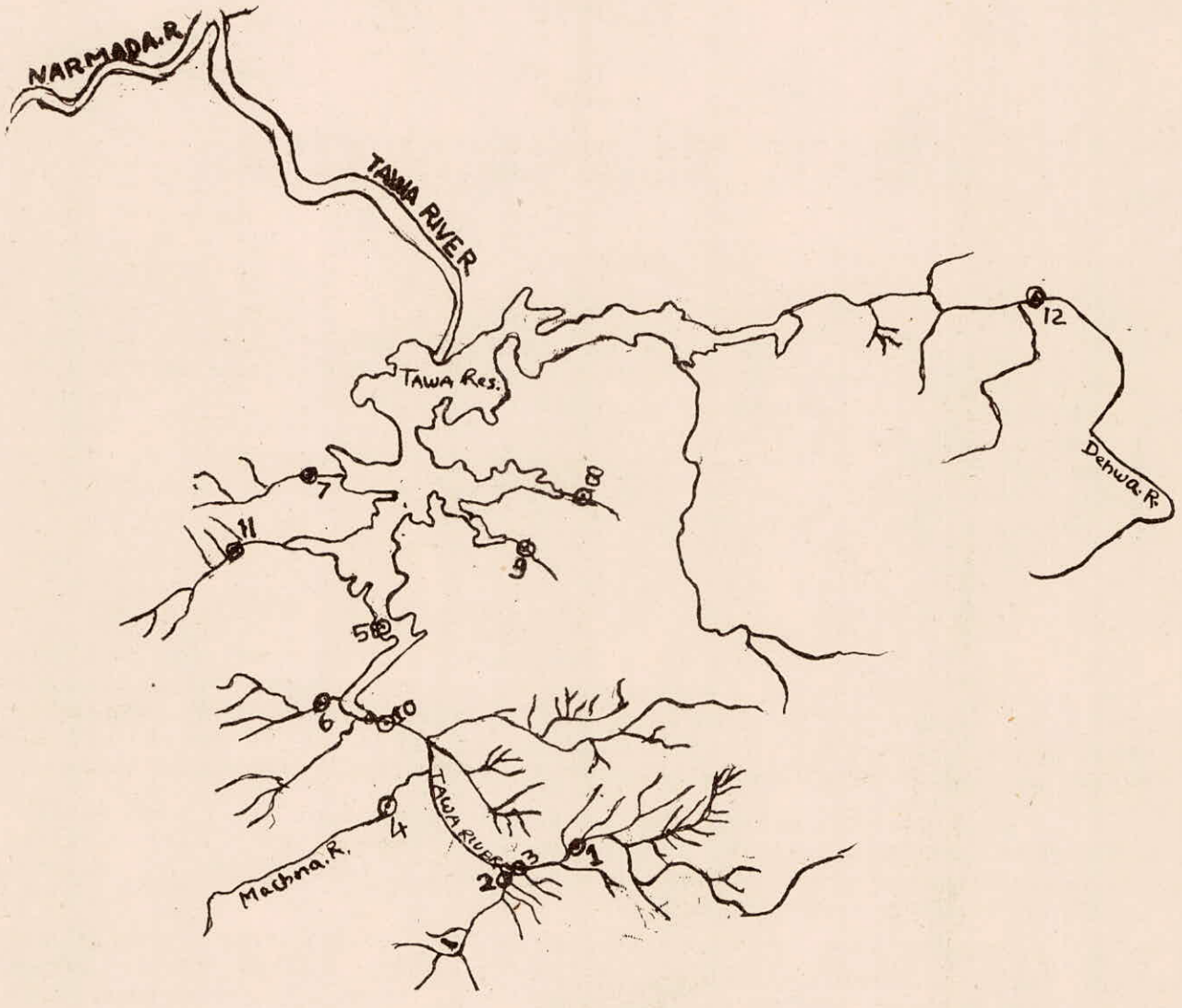

FIG 1. LOCATION OF SAMPLING SITES FOR TAWA RIVER

ved from earlier records that in the month of December the flow is nearly about 0.09 MAF and flow gradually decreases to nearly 1% during the month of May-June.

The most suitable period late December selected for estimation of chemical and suspended sediment characteristic during low flow.

2.0 METHODOLOGY

One litre water sample were collected in polythene bottles in the month of December (20 to 26 Dec.1986), represent low flow period Fig.1 shows the location of the sampling stations. The locations were chosen so as to represent all regions of the Tawa Catchment, major tributaries joining Tawa reservoir, their zone of mixing with river and reservoir, urban area, dam etc. PH were measured in the field with philips portable pH meter suspended sediments were seperated by 0.45 m Millipore Filteration in the laboratory. Cations (Na^+ K^+,Ca^{2+},Mg^{2+}) in water were determined using emission (for Na & K) and absorption (for Ca & Mg) mode of a GBC, AAS spectrophotometer. Conductivity was measured with systronics direct reading conductivity meter. Sulphate, phosphate and silicate were measured by standard colorimetric techniques. It was determined by $AgNo_3$ titration with potassium chromate as indicator. X ray diffraction was done for the suspended sediments for preliminary identification of the mineral present.

3.0 RESULTS AND DISCUSSION

Chemical Characteristics: The river water chemistry at various stations are summarized in Table 1. The average river water of Livingstone (1963) and the corrected values of Gibbs(1970), the Indian river water is alkaline. In general the alkalinity increases downstream for rivers, independently of catchment characteristics. The $H Co_3^-$ concentration are uniformly high and the observed pH are high. The water chemistry of Tawa river in the low flow do not show basin characteristics. Table II summarizes the average composition of Indian rivers. For comparison, Livingstone"s (1963) world average river is also shown.

Suspended Sediment: X-ray diffractograph taken for samples shown in Fig.2. The sediment appears to contain quartz, feldspar, chlorite, illite, kaolinite, montmorillonite, mixed layer clays, amphiboles.

The most abundant clay minerals in the Tawa catchment of Narmada basin is Illite followed by montmorillonite and equal small amount of chlorite & kaolinite.

Tawa river flow is controlled by two reservoirs constructed on the river. The Sarni reservoir constructed in the upstream while Tawa main dam reservoir is on the downstream. It has been found that on the upstream Sarni Dam chlorite clay mineral

TABLE 1: CHEMICAL CHARACTERISTICS OF TAWA RIVER (MP) DURING LOW FLOW (DEC. 1986)

River	Site	pH	Conductivity (mS/cm)	Concentration (PPM)										Remark
				Na^+	K^+	Ca^{++}	Mg^{++}	cl^-	HCO_3^-	PO_4^{3-}	SO_4^{2-}	Silica	TDS	
Tawa	Sarni Reservoir	7.96	0.153	12.46	0.29	13	6.9	5	95	0.11	2	23	158.99	Upstream of Tawa
Phophas	Ratamati	8.47	0.235	18.71	3.41	23.21	10.5	8	135	0.0	5	25.8	230.067	Tributaries of Tawa
Tawa	Dulhara	8.32	0.270	22.01	3.00	17.17	12.4	21	152.5	0.01	4	28.6	261.79	Downstream of Barmi Res.
Machna	Shahpur	8.48	0.395	32.03	3.06	12.29	27.6	10	285	0.01	1.5	31.7	407.31	end of Machna river
Tawa	Tawa Res.	7.88	0.164	11.91	0.7	16.49	8.4	6	110	0.02	1	17.2	171.74	Tawa Res.
Bhaura	Bhaura	8.44	0.313	25.17	2.32	18.03	14.0	19	220	0.02	1	21.0	321.176	Tributary of Tawa
Ghogra	Morpani	8.33	0.380	16.3	1.22	12.15	17.6	10	295	0.0	1.5	17.4	371.19	Tributary of Tawa
Malni	Malni	8.38	0.167	9.84	0.54	17.61	10.3	3	112	0.0	1	17.1	171.41	Tributary of Tawa Res.
Koti	Suplai	7.76	0.184	9.3	0.74	17.52	8.5	6	118	0.0	1.0	15.9	177.155	Tributary of Tawa Res.
Tawa	Bhaura	8.83	0.293	15.68	3.52	11.69	15.6	12	202	0.02	2.5	25.7	289.00	before meeting Tawa Res.
Suktawa	Suktawa	8.35	0.362	24.36	4.12	14.14	1	19	272	0.0	0.15	24.0	358.812	before meeting Tawa Res.
Denwa	Matkuli	7.5	0.12	7.60	0.44	14	4.10	12	60	0.02	0.5	22.5	121.17	end of Denwa river.

TABLE II

Average composition of river waters of India

River	pH	Concentration (ppm)									Source of original data
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^{-}	SO_4^{2-}	Cl^{-}	SiO_2^{0}	TDS	
Ganges	7.3	16.93	12.84	18.4	5.9	170.47	17.19	14.0	26.4	281	Handa (1972);
Brahmaputra	7.1	17.1	8.0	6.3	2.9	94.2	9.6	5.6	8.5	152	reported in Raymahasay (1970);
Indus	7.7	26.8	0.72	1.25	2.1	64.0	15.0	9.2	5.3	124	
Godavari	8.1	26.1	6.09	17.32	2.6	131.5	10.4	14.6	24.3	232	CSMRS (1973); Sikshamiah (1979)
Krishna	7.7	20.0	7.6	34.4	2.7	143.7	31.1	25.9	15.6	281	CSMRS (1973)
Mahanadi	7.5	10.4	9.5	10.2	1.5	61.2	31.3	14.6	9.1	155	
Narmada	8.2	17.0	12.4	9.0	6.6	108.4	21.4	30.0	19.9	224	CSMRS (1973)
Tapti	8.3	28.5	13.2	28.5	3.2	173.1	31.0	20.3	23.6	294	CSMRS (1973);
Cauvery	7.8	24.6	13.0	34.0	4.2	176.8	19.0	34.6	19.4	326	CSMRS (1973);
India average	7.7	23.08	6.29	3.73	2.32	90.77	11.36	6.28	14.73	159	discharge weighted
World average	6.1	15.0	4.1	6.3	2.3	58.4	11.2	7.8	13.1	120	Livingstone (1963)

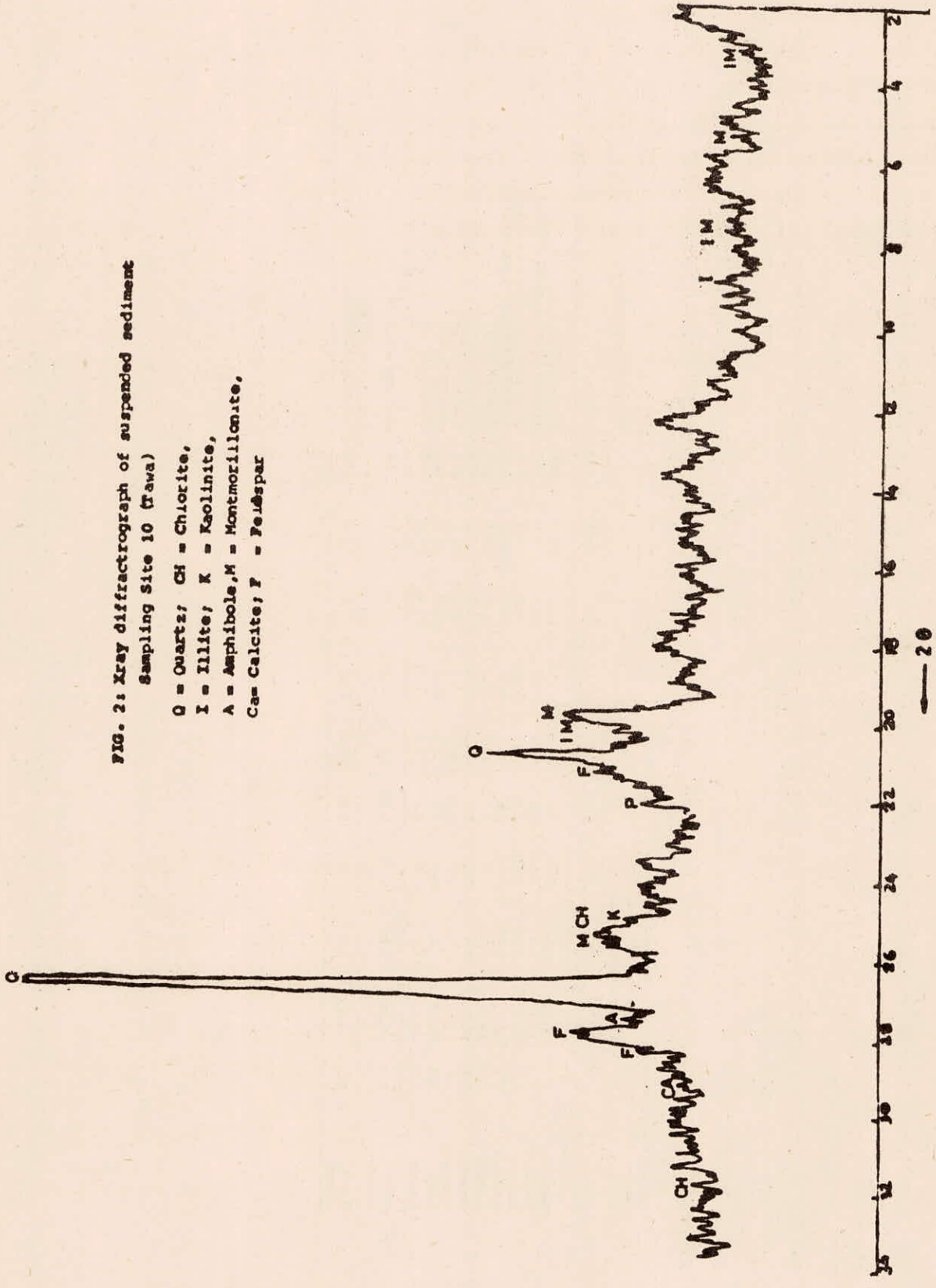

FIG. 2: Xray diffractograph of suspended sediment
Sampling Site 10 (Tawa)

Q = Quartz; CH = Chlorite,
I = Illite; K = Kaolinite,
A = Amphibole, M = Montmorillonite,
Ca= Calcite; F = Feldspar

percentage is higher than the montmorillonite & illite, while as river flows down the percentage of illite & montmorillonite increase. In the tawa reservoir illite is in abundance followed by montmorillonite, chlorite & kaolinite is in small amount. In the lower reaches due to sedimentation and size segregation due to mixing with reservoir water clay minerals gets settled and concentrated in bed sediment.

Quartz & Feldspar are present in all the tributaries suspended sediment. Both the quartz & Feldspar are the product of mechanical break down of igneous, metamorphic & sedimentry rocks of the catchment area. Due to atrition & physical weathering they become smaller in dimension and are carried as suspended sediment. The increase in feldspar in the reservoir tails suggest the low preferential leaching of K^{+} in feldspar due to chemical weathering and in turn depletes the clay in suspension of reservoir water. The depletion of quartz in the reservoir water indicate that quartz grains with clay get deposited in sediments. The high concentration of silica bed sediment support thus fact. Among corbonate delomite is the most predominent mineral. This is due to the precipitation of Ca, Mg bearing mineral.

Quantity of sediment discharges into Tawa reservoir does not reflect the actual sediment load because of the influence of upstream sarni reservoir, which traps the sediment. The lithology of the Tawa catchment especially of sedimentry rocks control the river water chemistry. Illite & Kaolinite are dominant clay mineral in suspended sediment. The average total dissolved solid is 253.3 PPm during low flow reflect Indian river water average.

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