

9

RESULTS

9.1 Results From Rainfall Analysis

Long term annual rainfall data for a period of almost three decades and daily rainfall data of Jhalod and Dahod taluka of a period 1996-2007 are used for analyzing rainfall pattern, rainfall characteristics and occurrence of drought condition in the study area. The analysis yield following results.

Table – 9.1 Summary of Rainfall Pattern

YEAR	JHALOD			DAHOD		
	Max. Rainy Days in one Month	Max. Rainfall in one Month	Min. Rainfall in one Month	Max. Rainy Days in one Month	Max. Rainfall in one Month	Min. Rainfall in one Month
		(mm.)	(mm.)		(mm.)	(mm.)
1996	18	509	17	15	312	38
1997	13	325	0	15	459	0
1998	16	521	61	16	294	46
1999	10	244	31	10	127	22
2000	9	109	0	13	125	0
2001	8	166	0	26	232	25
2002	13	195	0	13	218	0
2003	19	482	0	22	483	0
2004	14	278	0	23	898	2
2005	18	847	0	16	187	0
2006	18	684	0	25	568	8
2007	20	351	0	20	351	0

Table – 9.2 Summary Of Drought Analysis Jhalod (1981-2007)

Drought Condition	Years	Total	% of years
Mild Drought (Annual departure up to -0.25)	1981, 1982, 1983, 1984, 1988, 1993, 1997, 2004.	08	32.14
Normal Drought (Annual departure -0.25 to -0.50)	1986, 1991, 1992, 1995, 1999, 2003, 2005.	07	24.99
Severe Drought (Annual departure > -0.50)	1985, 1987, 1989, 2000, 2001, 2002	06	21.43
No Drought	1990, 1994, 1996, 1998, 2006, 2007	06	21.43

Table – 9.3 Summary Of Drought Analysis Dahod (1981-2001)

Drought Condition	Years	Total	% of years
Mild Drought (Annual departure up to -0.25)	1984, 1988, 1989, 1991, 1993, 1998, 2002	07	33.36
Normal Drought (Annual departure -0.25 to -0.50)	1982, 1987, 1992	03	12.51
Severe Drought (Annual departure > -0.50)	1985, 1986, 1995, 1999, 2000, 2001, 2005	07	29.19
No Drought	1981, 1983, 1990, 1996, 1997, 2006	06	25.02

9.2 Results of Morphometric Analysis

The catchment area of river Machhan is calculated as 431 km². The length of the Machhan river works out to be 45 km from the Sutharwasa village to the meeting point of Anas river. The overall summary of findings from Morphometric analysis are as follows

**Table – 9.4 Summarized Details of Various Drains
in Machhan Basin**

Drain Order	Number	Length (Km)
First Order Drains	1025	601.05
Second Order Drains	229	197.885
Third Order Drains	49	97.69
Fourth Order Drains	13	59.035
Fifth Order Drains	2	9.755

Table –9.5 Overall Summary of Morphometric Analysis

Sr. No.	Description	Particulars
1	Stream Orders	1 To 6
2	Total Stream Length	992 Km
3	Bifurcation Ratio	4.19
4	Drainage Density	2.327 Km/Km ²
5	Drainage Frequency	3.06 Numbers /Km ²
6	Total Relief	160 m
7	Relief Ratio	0.004645

9.3 Results Of Tank Model Analysis

Table 9.6 Results of Tank Model Output

Particular	1993	1994	1995	1996	1997
Total surface flow (m ³)	5×10^7	1.26×10^8	2.8×10^7	9.2×10^7	1.17×10^8
Total inter flow (m ³)	5.4×10^7	1.32×10^8	1.21×10^8	1.05×10^8	1.19×10^8
Total base flow (m ³)	4.8×10^7	1.41×10^8	1.6×10^8	1.07×10^8	1.87×10^8
Error (%)	4.20	0.04	2.24	11.12	1.12
RMSE (%)	11.75	16.15	40.05	25.91	30.88

Particular	1998	1999	2001	2003
Total surface flow (m ³)	5.6×10^7	2.2×10^7	1×10^7	9.4×10^7
Total inter flow (m ³)	9×10^7	4.7×10^7	4.2×10^7	8.5×10^7
Total base flow (m ³)	1.24×10^8	6×10^7	7.6×10^7	1.21×10^8
Error (%)	0.40	12.22	3.17	2.20
RMSE (%)	20.67	4.37	17.92	3.21

Table – 9.7 Summary of Analysis by Tank Model

Year	Runoff Observed (m ³)	Runoff Calc. (m ³)	Error %	RMSE %
1993	434.48400×10^5	416.21886×10^5	4.20	1.76
1994	1193.14512×10^5	1192.66579×10^5	0.04	6.16
1995	273.52080×10^5	267.37624×10^5	2.25	19.06
1996	1019.75328×10^5	906.27864×10^5	11.13	18.91
1997	1168.04160×10^5	1154.88144×10^5	1.13	20.88
1998	544.21920×10^5	541.99795×10^5	0.41	20.68
1999	238.22725×10^5	209.10461×10^5	12.22	4.38
2001	97.79105×10^5	94.68981×10^5	3.17	17.92
2003	874.97712×10^5	855.64867×10^5	2.21	3.22

Table 9.8 Effect of Same Check Dam in Different Zones

Component of Runoff	1 Check Dam In			
	1 st Zone	2 nd Zone	3 rd Zone	4 th Zone
	% Of Runoff When No Check Dam			
Surface Runoff	90.47	84.48	83.96	56.35
Inter flow	90.05	82.33	78.37	110.67
Base flow	78.15	82.74	101.03	102.56

Table – 9.9 Effect of Different Number of Check Dams

1994	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	1.26 X 10 ⁸	7.31 X 10 ⁷	5.52 X 10 ⁷	4.97 X 10 ⁷
Inter Flow (m ³)	1.32 X 10 ⁸	1.19 X 10 ⁸	1.03 X 10 ⁸	9.77 X 10 ⁷
Base Flow (m ³)	1.41 X 10 ⁸	1.44 X 10 ⁸	1.72 X 10 ⁸	1.96 X 10 ⁸
1995	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	5.45 X 10 ⁷	2.77 X 10 ⁷	2.18 X 10 ⁷	1.84 X 10 ⁷
Inter Flow (m ³)	1.10 X 10 ⁸	1.09 X 10 ⁸	9.30 X 10 ⁷	8.02 X 10 ⁷
Base Flow (m ³)	1.55 X 10 ⁸	1.57 X 10 ⁸	1.66 X 10 ⁸	1.72 X 10 ⁸
1998	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	1.54 X 10 ⁸	7.60 X 10 ⁷	5.82 X 10 ⁷	5.56 X 10 ⁷
Inter Flow (m ³)	1.72 X 10 ⁸	1.48 X 10 ⁸	1.12 X 10 ⁸	8.99 X 10 ⁷
Base Flow (m ³)	1.50 X 10 ⁸	1.57 X 10 ⁸	1.84 X 10 ⁸	2.17 X 10 ⁸
1999	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	6.74 X 10 ⁷	3.86 X 10 ⁷	2.59 X 10 ⁷	2.23 X 10 ⁷
Inter Flow (m ³)	7.41 X 10 ⁷	6.94 X 10 ⁷	5.64 X 10 ⁷	4.73 X 10 ⁷
Base Flow (m ³)	7.07 X 10 ⁷	7.52 X 10 ⁷	8.42 X 10 ⁷	9.40 X 10 ⁷
2001	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	4.66 X 10 ⁷	1.91 X 10 ⁷	1.07 X 10 ⁷	1.04 X 10 ⁷
Inter Flow (m ³)	7.01 X 10 ⁷	6.14 X 10 ⁷	4.76 X 10 ⁷	4.18 X 10 ⁷
Base Flow (m ³)	7.62 X 10 ⁷	8.79 X 10 ⁷	9.08 X 10 ⁷	9.30 X 10 ⁷

2003	No Check Dam	1 Check Dam	2 Check Dams	3 Check Dams
Surface Flow (m ³)	2.19 X 10 ⁸	1.47 X 10 ⁸	1.27 X 10 ⁸	9.41 X 10 ⁷
Inter Flow (m ³)	1.62 X 10 ⁸	1.56 X 10 ⁸	1.07 X 10 ⁸	8.50 X 10 ⁷
Base Flow (m ³)	1.61 X 10 ⁸	1.67 X 10 ⁸	1.74 X 10 ⁸	1.98 X 10 ⁸

Table – 9.10 Variation in Surface Flow From 1 Check Dam to 3 Check Dams in % of No Check Dam Condition

Condition	1994	1995	1998	1999	2001	2003
	Variation In % of No Check Dam Condition					
1 Check Dam	-41.98	-49.17	-50.65	-42.73	-59.01	-32.88
2 Check Dams	-56.19	-60.00	-62.21	-61.57	-77.04	-42.01
3 Check Dams	-60.56	-66.24	-63.90	-66.91	-77.68	-57.03

(Note: -ve sign indicates reduction in flow)

Table – 9.11 Variation in Inter Flow From 1 Check Dam to 3 Check Dams in % of No Check Dam Condition

Condition	1994	1995	1998	1999	2001	2003
	Variation In % of No Check Dam Condition					
1 Check Dam	-9.85	-0.91	-13.95	-6.34	-12.41	-3.70
2 Check Dams	-21.97	-15.45	-34.88	-23.89	-22.48	-31.41
3 Check Dams	-25.98	-27.09	-47.73	-36.17	-31.92	-45.51

(Note: -ve sign indicates reduction in flow)

Table – 9.12 Variation in Base Flow From 1 Check Dam to 3 Check Dams in % of No Check Dam Condition

Condition	1994	1995	1998	1999	2001	2003
	Variation In % of No Check Dam Condition					
1 Check Dam	2.13	1.29	4.67	6.36	15.35	3.73
2 Check Dams	21.99	7.10	22.67	19.09	19.16	8.07
3 Check Dams	39.01	10.97	44.67	32.96	22.05	22.98