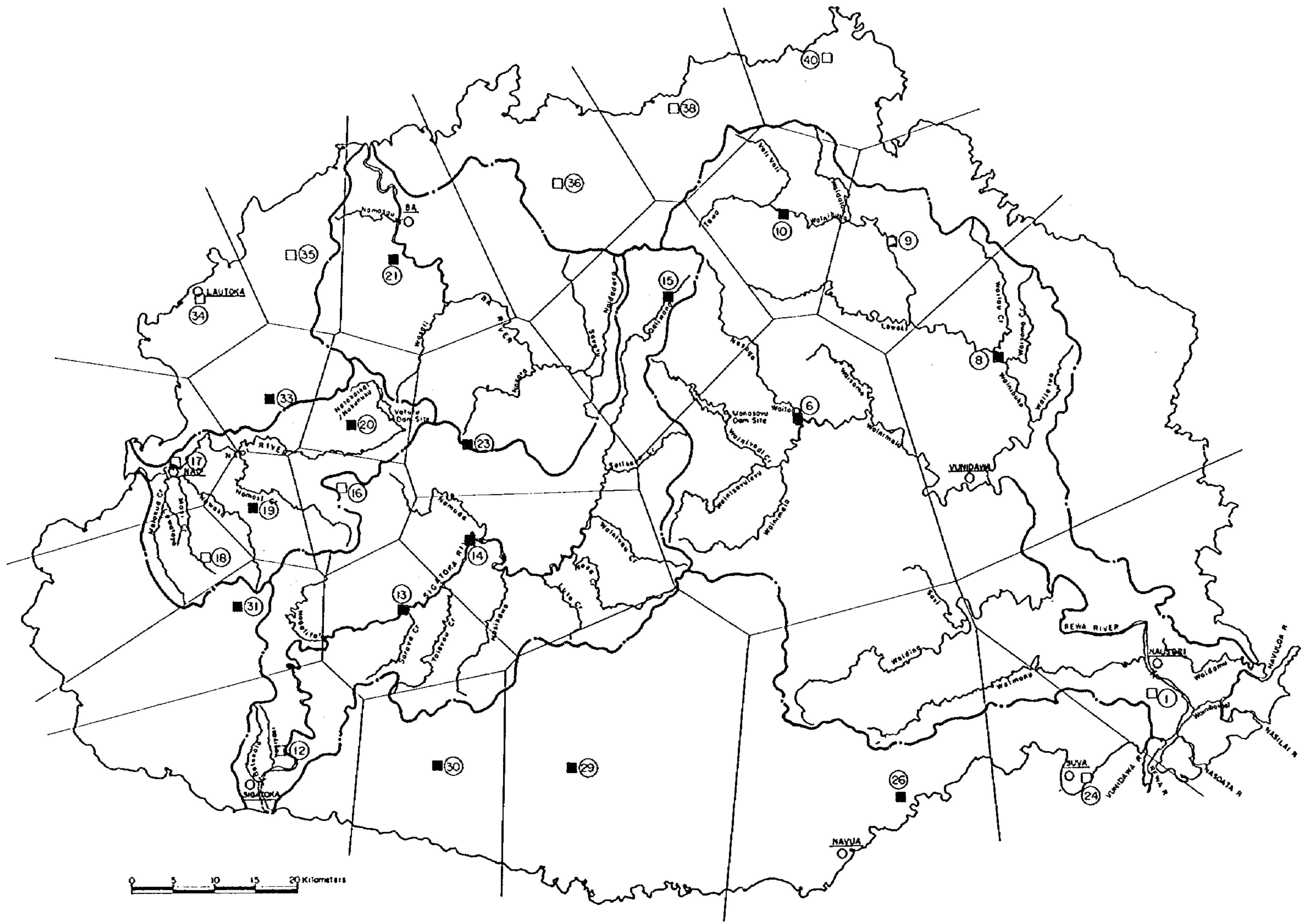
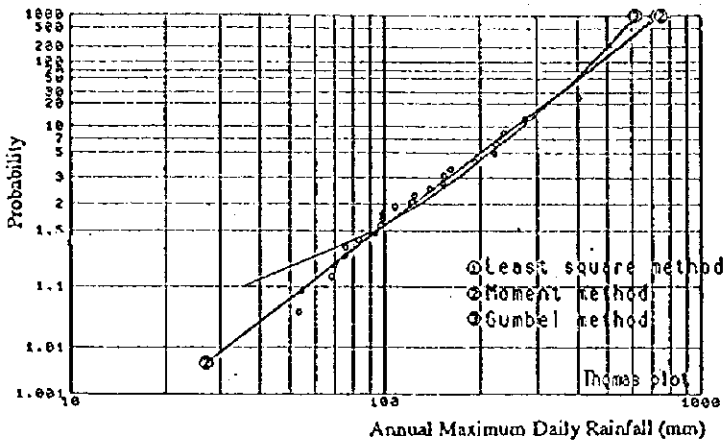
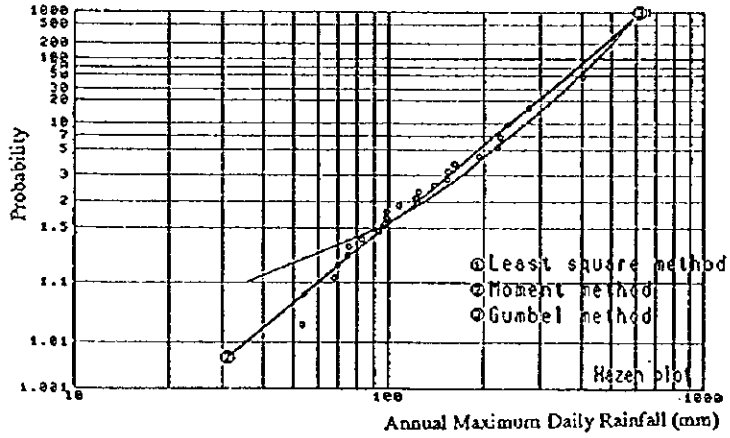


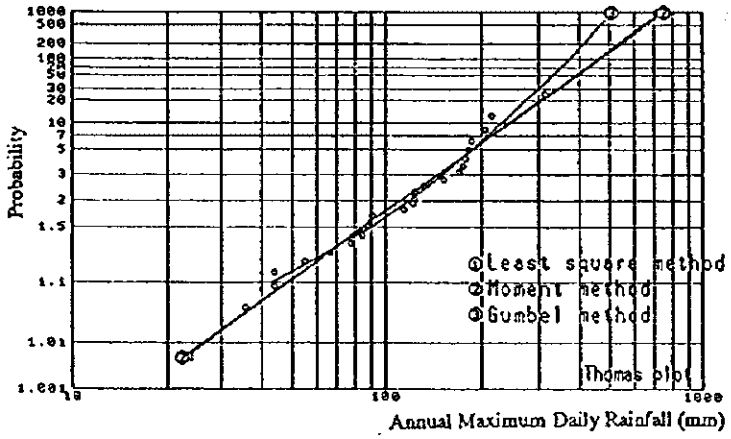
Figure-3.7 Thiessen Polygons



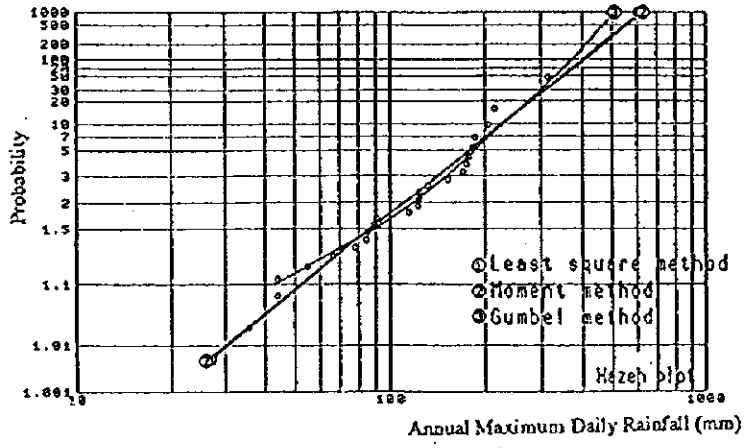
Log Normal Curve Paper for Rewa



Log Normal Curve Paper for Rewa

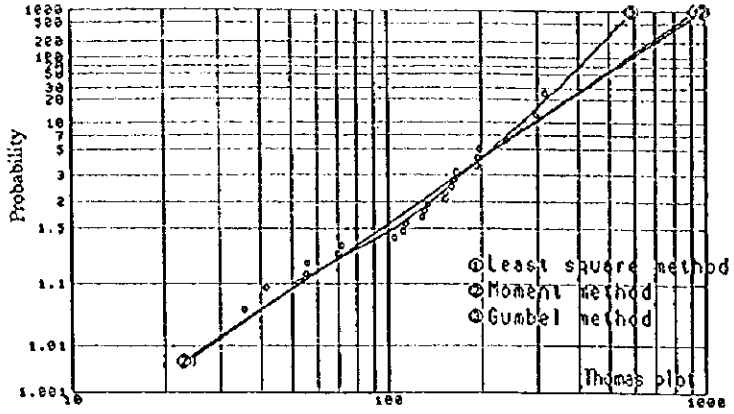


Log Normal Curve Paper for Sigatoka

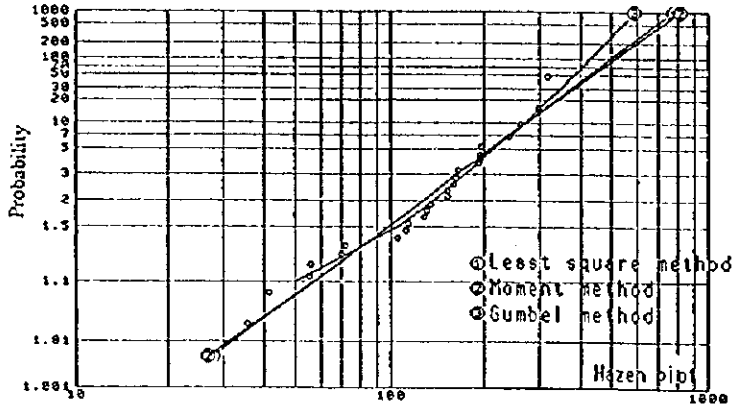


Log Normal Curve Paper for Sigatoka i

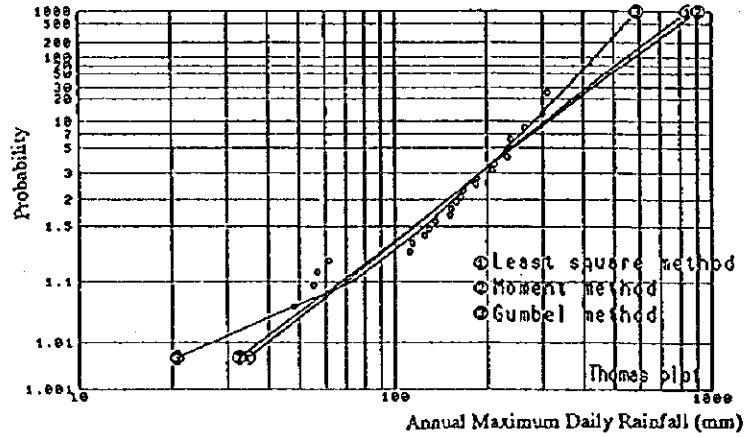
Figure-3.8 (1/2) Thomas and Hazen Plot of Annual Maximum Daily Rainfall



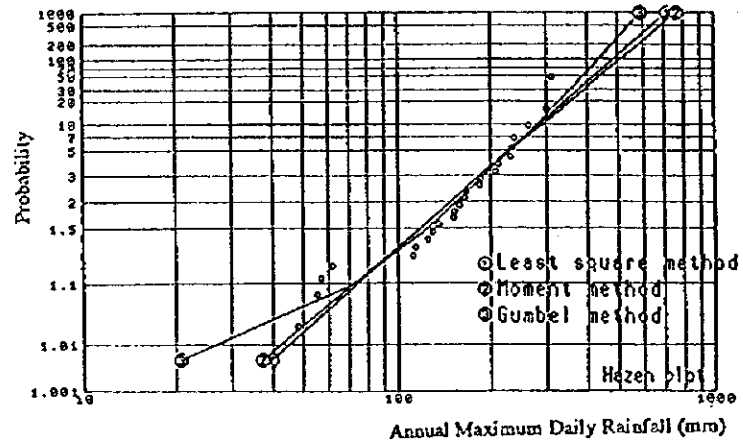
Log Normal Curve Paper for Nadi



Log Normal Curve Paper for Nadi



Log Normal Curve Paper for Ba



Log Normal Curve Paper for Ba

Figure-3.8 (2/2) Thomas and Hazen Plot of Annual Maximum Daily Rainfall

The above table shows the deviation of each method from the data. However, the main concern of this study is higher values of rainfall. As shown in Figure-3.8, least squares and moment methods by the Hazen plot fit the higher rainfall better than those by Thomas plot for Rewa and Sigatoka watershed, while those by Thomas plot are preferable for Nadi and Ba watershed.

The Gumbel method is the most suitable method to describe the annual maximum daily rainfall in Viti Levu. Although the deviation throughout all data is not satisfactory in the Rewa watershed compared to other methods, it is the best fitting method for the higher values. For the other watersheds, the Gumbel method fits throughout the data, inclusive of the higher values.

Applying the Gumbel method, the relation between return period and amount of rainfall was determined. The results are shown in Table-3.7.

The probable rainfalls are almost same with the exception of Sigatoka where the probable rainfalls are less than the other watersheds. This is probably due to tracks of cyclones and topographical features. Regarding the tracks of cyclones which hit Viti Levu, there are two tracks, one passing from the north to east side of Viti Levu and the other passing western Viti Levu (Nadi). Since the Sigatoka watershed is bounded on the west by Nausori highland with an altitude of 500 ~ 900 m and on the east by Nadrau Plateau with an altitude of 900 ~ 1,200 m, cyclones which hit Viti Levu with either track will be depressed by these mountain chains. Since the other three watersheds are open to the tracks of cyclones, their probable rainfalls are greater than those in Sigatoka watershed.

Table-3.7 Return Period of Rainfall by Gumbel Method

Return Period (years)	Rainfall in Rewa Watershed (mm/day)	Rainfall in Sigatoka Watershed (mm/day)	Rainfall in Nadi Watershed (mm/day)	Rainfall in Ba Watershed (mm/day)
100	450	375	430	440
50	395	330	385	390
30	355	300	350	360
20	325	275	320	330
10	270	235	270	280
5	215	190	215	235
2	130	120	140	160

3.5 Runoff Analysis

In Viti Levu Island, there are 7 staff gauge stations and 27 gauging stations with automatic recorders operated as of August, 1996. Of the 27 gauging stations, 5 stations are located where there is tidal influence. All gauging stations are operated and maintained by Hydrological Section, Public Works Department (PWD).

Considering the availability of data, 20 gauging stations were initially selected, 13 stations still operated and 7 stations now closed. After analyzing the data, 14 stations out of 20 stations were re-selected as shown in Figure-3.9 because of the limitation of data and tidal influence. Runoff analysis of Low Water was conducted using the data from these 14

stations; however, stations selected for runoff analysis of High Water vary depending on the target floods.

3.5.1 Low Water

Mean daily discharge was used for this analysis. Since there are still lots of data gaps even after the re-selection of gauging stations, the period of analysis could not be fixed. As many data as possible were used.

(1) Flow Regime

Flow regime of each station was analyzed based on the above data to determine the discharge characteristics. Analysis was conducted for years having at least 200 days' data available. Based on the discharge histogram, flow regime was obtained. Flow regimes of years with data gaps were extended to 365 days. For example, 26 % of the 200 day discharge histogram was adopted as High Discharge assuming that even 200 days' data describes the annual flow characteristics. The result is summarized in Table-3.8 showing the duration curve of the typical year. Since observation days of discharge for a year vary annually due to data gaps, the duration curve of mean flow regime is not obtainable. Therefore, the duration curve of a year whose flow regime is close to average value was drawn as a typical duration curve.

Based on the duration curve, the following discharges are defined for the utilization of water resources, such as water development and hydro-power, etc.

1) High Discharge: 95th daily discharge from the maximum, discharge exceeding this volume for 95 days in a year (26 % of a year)
2) Normal Discharge: 185th daily discharge from the maximum, discharge exceeding this volume for 185 days in a year (50 % of a year)
3) Low Discharge: 275th daily discharge from the maximum, discharge exceeding this volume for 275 days in a year (75 % of a year)
4) Drought Discharge: 355th daily discharge from the maximum, discharge exceeding this volume for 355 days in a year (97 % of a year)

The main characteristic of flow regime in Viti Levu is a sharp decline after the maximum. It implies that the sub-surface runoff, recharge of groundwater and water storage of the watersheds are small.

Ref. No.	Selected Station for Analysis	No.	Station Name	Watershed	Catchment Area (km2)	Latitude	Longitude
1		LA023	NAUSORI-CRT	REWA	2903	18°01'S	178°31'E
2		LA002	DREINAKELO	REWA	2677	17°58'S	178°31'E
3	Y	HA010	WAIMANU	REWA	165	18°02'S	178°27'E
4	Y	HA006	NABUKALUKA	REWA	253	17°58'S	178°19'E
5	Y	HA149	NATUBA	REWA	146	17°54'S	178°16'E
6	Y	HA009	NAVOLAU	REWA	1961	17°52'S	178°23'E
7	Y	HA008	NAIRUKURUKU	REWA	790	17°48'S	178°16'E
8	Y	HA143	NAYAVU	REWA	706	17°41'S	178°21'E
9	Y	HA155	DOBUILEVU	REWA	316	17°33'S	178°14'E
10	Y	HA090	NAMOKA	SIGATOKA	1333	18°02'S	177°38'E
11		HA024	NALEBAILEBA	SIGATOKA	1120	18°57'S	177°40'E
12		HA195	NUKUILAU	SIGATOKA	443	17°53'S	177°51'E
13		LA001	NADI-BRIDGE	NADI	333	17°47'S	177°25'E
14	Y	HA100	NATUACERE	NADI	70	17°50'S	177°28'E
15	Y	HA021	YAVUNA	NADI	62	17°43'S	177°33'E
16	Y	HA020	VOTUALEVU	NADI	164	17°46'S	177°30'E
17		LA032	NAMOSAU-Br	BA	940	17°32'S	177°40'E
18	Y	HA093	TOGE	BA	579	17°37'S	177°44'E
19	Y	HA161	NAVALA	BA	323	17°39'S	177°48'E
20	Y	HA062	KORO	BA	62	17°42'S	177°54'E

Y: finally selected station for analysis
HA: station with no tidal influence
LA: station with tidal influence

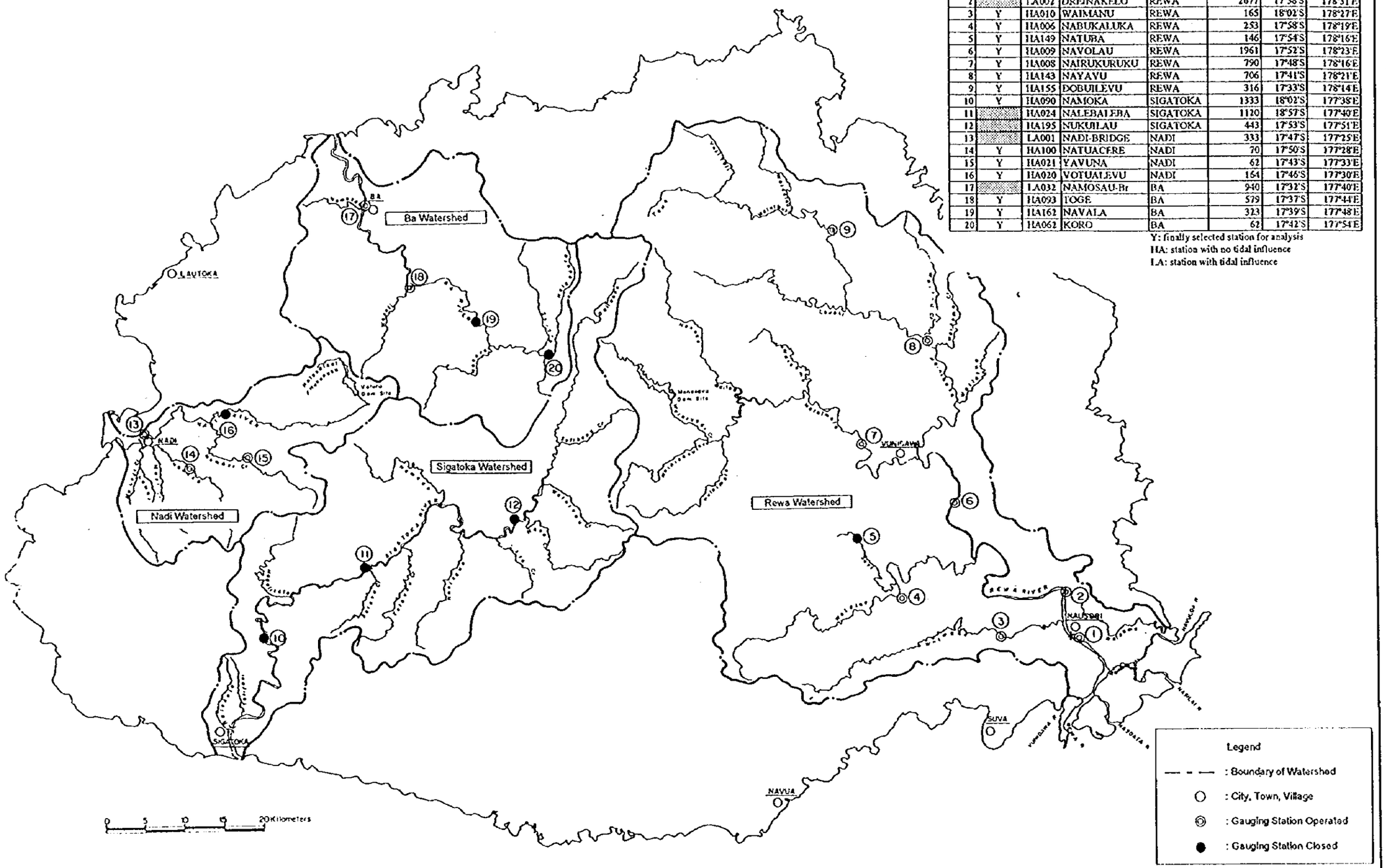
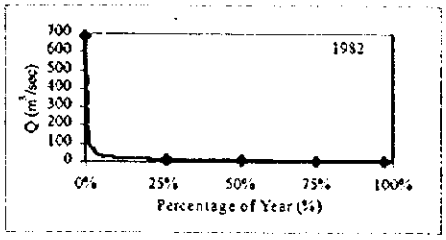


Figure-3.9 Location of Selected Gauging Stations for Runoff Analysis

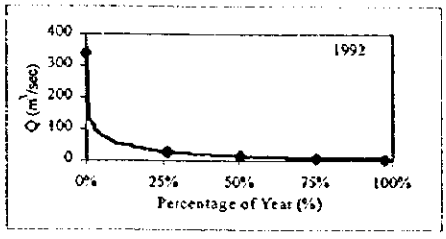
Table-3.8 (1/3) Flow Regime of Selected Gauging Stations

Rewa Tributary — Waimanu (HA010)
Ref. No.: 3
Catchment Area: 165 km²



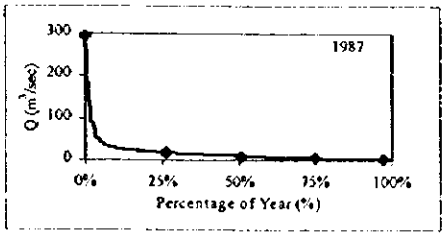
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1972	991.0	18.0	11.0	9.0	5.0	5.0
1973	291.0	10.0	8.0	6.0	1.0	1.0
1977	394.0	12.0	7.0	4.0	3.0	2.0
1978	247.0	14.0	8.0	5.0	3.0	2.0
1979	1771.0	15.0	9.0	5.0	3.0	3.0
1980	4044.0	13.0	8.0	5.0	3.0	2.0
1981	128.0	12.0	9.0	6.0	4.0	4.0
1982	***689.0***	***15.0***	***11.0***	***9.0***	***7.0***	***7.0***
1983	309.0	14.0	10.0	8.0	6.0	5.0
1984	527.0	18.0	15.0	14.0	10.0	9.0
1985	540.0	12.0	7.0	4.0	1.0	1.0
1987	2334.0	11.0	7.0	4.0	3.0	3.0
1988	192.0	18.0	10.0	7.0	5.0	4.0
1989	154.0	12.0	9.0	7.0	5.0	3.0
1990	515.0	16.0	8.0	6.0	4.0	3.0
1991	398.0	14.0	7.0	5.0	3.0	3.0
1992	443.0	14.0	6.0	4.0	1.0	1.0
1993	2755.0	21.0	13.0	7.0	4.0	4.0
1994	181.0	17.0	8.0	5.0	4.0	3.0
1995	237.0	19.0	11.0	7.0	5.0	5.0
Average	857.0	15.0	9.0	6.0	4.0	4.0

Rewa Tributary — Nabukaluka (HA006)
Station No.: 4
Catchment Area: 253 km²



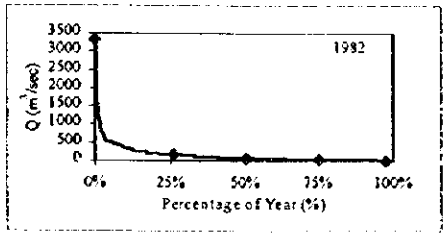
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1970	234.0	25.0	8.0	4.0	3.0	2.0
1971	373.0	20.0	9.0	5.0	3.0	3.0
1972	583.0	35.0	16.0	7.0	3.0	2.0
1973	293.0	42.0	25.0	14.0	5.0	4.0
1974	224.0	29.0	16.0	7.0	3.0	3.0
1975	298.0	26.0	11.0	4.0	2.0	1.0
1976	134.0	34.0	20.0	13.0	8.0	6.0
1977	406.0	27.0	8.0	2.0	1.0	1.0
1978	296.0	28.0	16.0	9.0	3.0	2.0
1979	283.0	23.0	13.0	8.0	3.0	3.0
1980	895.0	28.0	18.0	10.0	7.0	6.0
1981	120.0	20.0	10.0	6.0	4.0	2.0
1982	353.0	24.0	13.0	10.0	7.0	4.0
1983	196.0	15.0	9.0	6.0	4.0	4.0
1984	126.0	20.0	13.0	7.0	4.0	4.0
1985	240.0	22.0	14.0	9.0	5.0	4.0
1986	536.0	23.0	10.0	5.0	2.0	2.0
1989	102.0	24.0	17.0	11.0	3.0	2.0
1991	209.0	28.0	11.0	5.0	2.0	1.0
1992	***339.0***	***28.0***	***15.0***	***9.0***	***7.0***	***5.0***
1994	255.0	50.0	36.0	26.0	19.0	18.0
1995	250.0	59.0	45.0	36.0	28.0	26.0
Average	307.0	29.0	16.0	10.0	6.0	5.0

Rewa Tributary — Natuva (HA149)
Station No.: 5
Catchment Area: 146 km²



Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1980	1255.0	20.0	12.0	6.0	3.0	2.0
1981	281.0	17.0	10.0	5.0	3.0	3.0
1982	292.0	17.0	10.0	7.0	5.0	5.0
1983	366.0	16.0	9.0	5.0	3.0	3.0
1984	392.0	20.0	13.0	7.0	3.0	3.0
1985	301.0	17.0	9.0	5.0	3.0	2.0
1986	647.0	15.0	7.0	4.0	3.0	3.0
1987	***294.0***	***18.0***	***10.0***	***5.0***	***3.0***	***2.0***
1988	97.0	26.0	17.0	12.0	8.0	7.0
1989	182.0	19.0	13.0	7.0	3.0	3.0
1991	50.0	17.0	9.0	5.0	3.0	3.0
1992	154.0	24.0	15.0	9.0	5.0	4.0
Average	359.0	19.0	11.0	6.0	4.0	3.0

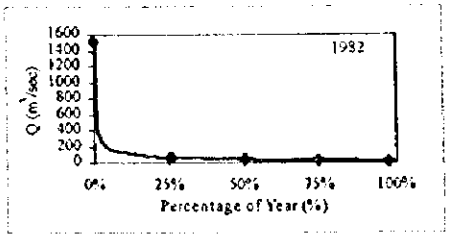
Rewa Main — Navolau (HA009)
Station No.: 6
Catchment Area: 1961 km²



Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1971	1345.0	169.0	73.0	34.0	18.0	15.0
1972	6711.0	199.0	122.0	71.0	33.0	29.0
1977	655.0	57.0	26.0	17.0	10.0	9.0
1978	2057.0	165.0	53.0	24.0	8.0	6.0
1979	2259.0	124.0	68.0	40.0	23.0	22.0
1980	4218.0	152.0	77.0	39.0	20.0	16.0
1981	1362.0	116.0	48.0	15.0	2.0	1.0
1982	***3311.0***	***163.0***	***73.0***	***38.0***	***17.0***	***17.0***
1984	2703.0	171.0	97.0	68.0	32.0	31.0
1985	3960.0	128.0	81.0	60.0	48.0	45.0
1988	2054.0	230.0	130.0	90.0	73.0	68.0
1991	2221.0	132.0	40.0	24.0	16.0	13.0
1993	6925.0	132.0	65.0	46.0	32.0	28.0
1994	1112.0	158.0	69.0	49.0	34.0	34.0
1995	1305.0	159.0	88.0	51.0	29.0	20.0
Average	2813.0	150.0	74.0	44.0	26.0	24.0

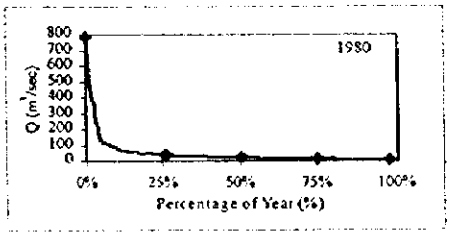
Table-3.8 (2/3) Flow Regime of Selected Gauging Stations

Rewa Tributary — Nairukuruku (HA008)
Station No.: 7
Catchment Area: 790 km²



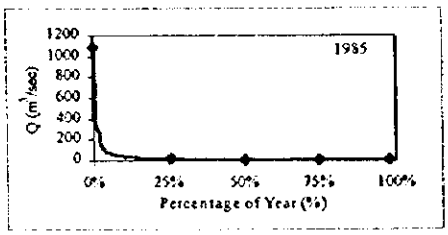
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1978	833.0	52.0	33.0	26.0	19.0	18.0
1979	877.0	45.0	30.0	21.0	13.0	11.0
1980	2161.0	65.0	40.0	22.0	10.0	9.0
1981	535.0	50.0	25.0	16.0	8.0	6.0
1982	***1526.0***	***68.0***	***42.0***	***30.0***	***18.0***	***15.0***
1983	2132.0	50.0	25.0	14.0	11.0	10.0
1984	1320.0	62.0	38.0	23.0	15.0	13.0
1985	2628.0	55.0	34.0	26.0	21.0	19.0
1986	832.0	49.0	31.0	23.0	19.0	15.0
1987	1027.0	53.0	29.0	21.0	18.0	17.0
1988	478.0	67.0	38.0	31.0	26.0	25.0
1989	383.0	58.0	36.0	28.0	22.0	21.0
1990	2769.0	78.0	55.0	46.0	32.0	28.0
1991	779.0	65.0	40.0	29.0	24.0	22.0
1992	2085.0	60.0	45.0	36.0	27.0	22.0
1994	589.0	63.0	51.0	46.0	37.0	35.0
1995	751.0	133.0	91.0	66.0	46.0	42.0
Average	1277.0	63.0	40.0	30.0	22.0	19.0

Rewa Tributary — Nayavu (HA143)
Station No.: 8
Catchment Area: 706 km²



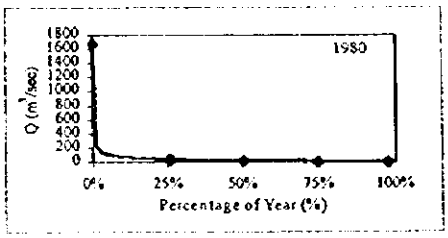
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1979	608.0	30.0	18.0	13.0	9.0	8.0
1980	***782.0***	***39.0***	***23.0***	***14.0***	***9.0***	***7.0***
1981	878.0	33.0	20.0	13.0	11.0	10.0
1982	533.0	40.0	23.0	16.0	12.0	11.0
1983	488.0	21.0	13.0	10.0	7.0	6.0
1984	1458.0	39.0	24.0	13.0	9.0	9.0
1985	779.0	35.0	23.0	16.0	11.0	10.0
1986	1556.0	32.0	19.0	10.0	8.0	7.0
1987	673.0	34.0	18.0	11.0	6.0	5.0
1988	537.0	56.0	35.0	22.0	9.0	9.0
1989	641.0	42.0	22.0	15.0	10.0	9.0
1990	1885.0	38.0	26.0	19.0	10.0	8.0
1991	225.0	39.0	26.0	20.0	8.0	2.0
1992	255.0	21.0	13.0	9.0	4.0	3.0
1993	569.0	32.0	19.0	13.0	9.0	8.0
1994	548.0	31.0	14.0	9.0	7.0	7.0
1995	908.0	39.0	26.0	17.0	10.0	8.0
Average	784.0	35.0	21.0	14.0	9.0	7.0

Rewa Tributary — Dovutlevu (HA155)
Station No.: 9
Catchment Area: 316 km²



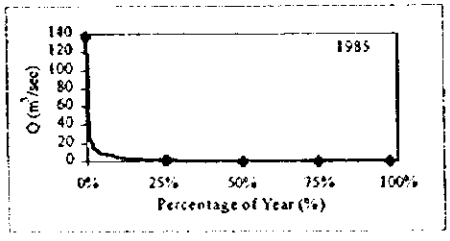
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1984	964.0	20.0	14.0	11.0	9.0	8.0
1985	***1088.0***	***20.0***	***13.0***	***11.0***	***8.0***	***8.0***
1987	293.0	17.0	11.0	7.0	7.0	6.0
1988	252.0	25.0	13.0	9.0	7.0	6.0
1989	631.0	25.0	14.0	9.0	8.0	8.0
1992	1160.0	18.0	7.0	3.0	1.0	1.0
1993	2012.0	21.0	8.0	6.0	4.0	2.0
1994	602.0	15.0	8.0	6.0	5.0	4.0
1995	266.0	19.0	10.0	6.0	5.0	4.0
Average	808.0	20.0	11.0	8.0	6.0	5.0

Sigatoka Main — Namoka (HA090)
Station No.: 10
Catchment Area: 1333 km²



Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1979	204.4	23.1	11.9	7.6	3.8	2.9
1980	***1676.0***	***39.0***	***13.0***	***9.0***	***7.0***	***4.0***
1981	889.6	22.6	11.8	6.3	3.9	3.3
1982	2141.0	61.0	14.0	8.0	5.0	4.0
1983	1005.0	40.0	26.0	22.0	9.0	5.0
Average	1183.0	37.0	15.0	11.0	6.0	4.0

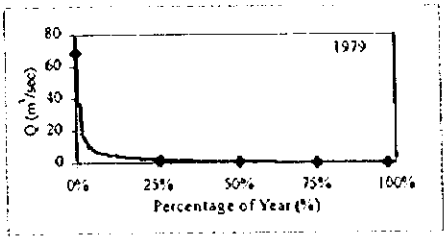
Nadi Tributary — Nawaka (HA100)
Station No.: 14
Catchment Area: 70 km²



Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1977	2.2	0.3	0.2	0.1	0.1	0.1
1978	14.2	0.5	0.3	0.2	0.1	0.1
1979	137.1	2.1	0.5	0.3	0.2	0.2
1980	53.3	2.7	0.6	0.3	0.2	0.2
1981	129.2	1.7	0.8	0.3	0.1	0.1
1982	35.3	1.9	0.7	0.3	0.1	0.1
1983	563.6	2.2	1.5	0.5	0.2	0.1
1984	167.0	0.9	0.2	0.1	0.1	0.1
1985	***137.3***	***0.9***	***0.3***	***0.2***	***0.1***	***0.1***
1987	17.2	0.4	0.2	0.1	0.1	0.1
1988	14.9	1.0	0.4	0.2	0.2	0.1
1989	370.9	2.9	0.6	0.3	0.1	0.1
1990	72.0	0.7	0.4	0.2	0.1	0.1
1991	31.6	1.8	0.4	0.1	0.1	0.1
1992	1.6	0.2	0.1	0.1	0.1	0.1
1993	26.9	1.1	0.3	0.1	0.1	0.1
1994	164.9	2.7	0.1	0.1	0.0	0.0
Average	114.1	1.4	0.4	0.2	0.1	0.1

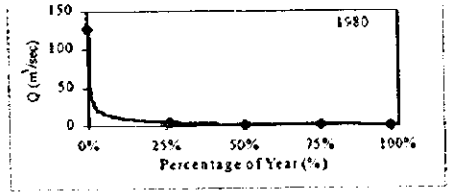
Table-3.8 (3/3) Flow Regime of Selected Gauging Stations

Nadi Tributary — Yavuna (HA021)
Station No.: 15
Catchment Area: 62 km²



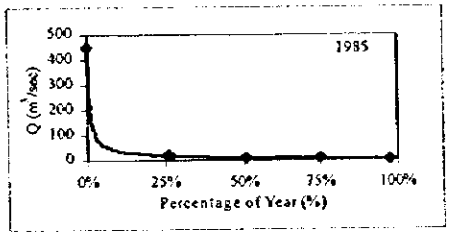
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1977	31.4	0.9	0.4	0.2	0.1	0.1
1978	6.1	0.4	0.2	0.1	0.1	0.1
1979	***68.8***	***1.8***	***0.6***	***0.3***	***0.2***	***0.1***
1980	32.4	0.9	0.3	0.2	0.1	0.1
1981	66.1	0.9	0.4	0.3	0.2	0.1
1982	48.9	1.9	0.6	0.3	0.1	0.1
1983	19.1	1.7	1.2	0.7	0.2	0.1
1984	92.7	2.0	0.4	0.2	0.1	0.1
1985	119.3	2.0	0.9	0.5	0.3	0.3
1986	117.8	1.5	0.3	0.1	0.1	0.1
1987	8.6	0.6	0.3	0.1	0.1	0.1
1988	3.6	1.5	0.3	0.2	0.1	0.1
1989	23.6	2.9	0.5	0.2	0.1	0.1
1990	80.7	0.5	0.2	0.1	0.1	0.1
1991	7.2	0.3	0.1	0.1	0.1	0.1
1992	1.9	0.2	0.1	0.1	0.1	0.1
1995	17.2	0.7	0.4	0.2	0.1	0.1
Average	43.8	1.2	0.4	0.2	0.1	0.1

Nadi Main — Votualevu (HA020)
Station No.: 16
Catchment Area: 164 km²



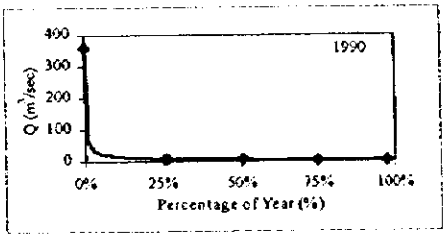
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1980	***127.0***	***4.5***	***1.8***	***1.1***	***0.5***	***0.5***
1981	127.3	4.3	2.7	1.3	0.7	0.6
1982	415.0	5.9	1.9	0.7	0.2	0.1
1984	87.6	9.5	6.9	5.7	2.6	2.3
1986	378.0	6.6	5.3	4.5	4.2	4.2
1988	84.0	7.7	4.5	3.2	2.3	2.2
Average	203.2	6.4	3.9	2.8	1.8	1.7

Ba Main — Toge (HA093)
Station No.: 18
Catchment Area: 579 km²



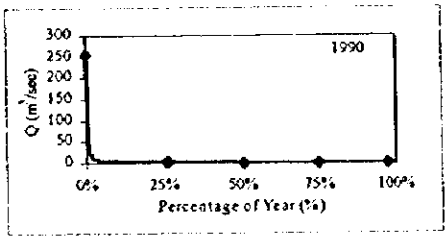
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1980	185.5	17.7	6.8	5.4	2.4	1.8
1981	276.9	12.2	7.9	5.3	3.7	3.4
1982	1879.0	18.0	8.0	6.0	4.0	4.0
1983	1119.0	10.0	5.0	4.0	3.0	3.0
1984	1379.0	20.0	10.0	5.0	3.0	3.0
1985	***451.9***	***17.9***	***10.3***	***7.6***	***5.0***	***4.8***
1986	1574.0	13.0	6.0	3.0	3.0	3.0
1987	159.2	6.2	3.3	2.6	2.1	2.1
1988	120.3	9.4	6.2	4.4	3.2	2.8
1990	96.1	11.4	7.9	6.1	5.4	5.4
1991	186.0	13.8	6.2	5.4	4.6	4.2
1992	162.7	6.8	5.0	3.9	3.0	3.0
1995	276.3	10.6	5.1	3.5	3.1	3.1
Average	605.0	13.0	7.0	5.0	4.0	3.0

Ba Main — Navala (HA162)
Station No.: 19
Catchment Area: 323 km²



Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1983	604.3	7.8	4.3	3.4	2.7	2.7
1984	590.2	15.8	8.0	4.0	2.7	2.5
1985	986.8	13.1	6.2	4.3	3.3	2.8
1986	231.0	7.9	4.6	3.3	2.6	2.6
1987	117.2	5.1	2.9	2.2	1.8	1.8
1988	299.6	8.1	4.5	3.0	2.5	2.5
1989	344.9	21.8	7.6	4.9	3.6	3.4
1990	***358.3***	***8.8***	***6.2***	***5.2***	***4.3***	***4.1***
1991	508.0	9.6	4.2	3.3	2.7	2.6
1992	104.4	4.8	2.8	2.4	1.8	1.8
Average	414.0	10.0	5.0	4.0	3.0	3.0

Ba Main — Koro (HA062)
Station No.: 20
Catchment Area: 62 km²

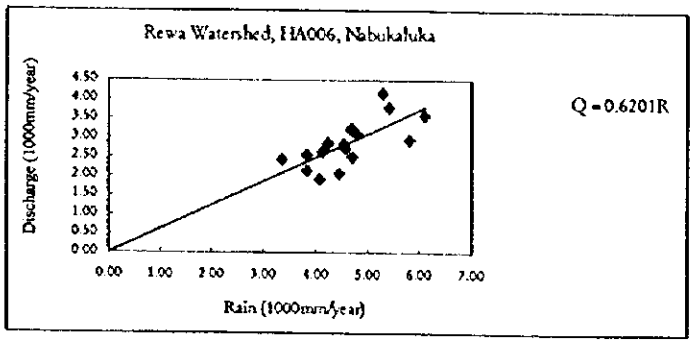


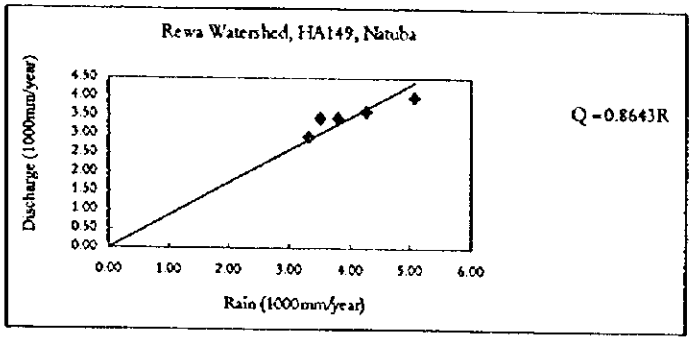
Year	Max	Q26%	Q50%	Q75%	Q97%	Min
1990	***256.3***	***2.2***	***1.5***	***1.2***	***1.0***	***0.9***
1991	861.3	4.9	2.5	2.0	1.2	1.1
1992	45.2	1.3	1.0	0.8	0.6	0.6
Average	387.6	2.8	1.7	1.3	0.9	0.9

(2) Runoff Coefficients

The relation between annual discharge and annual rainfall was analyzed to determine runoff coefficients. The sum of mean daily discharge in a year was divided by the area of watershed in order to compare with annual rainfall. Least squares method was employed to correlate discharge and rainfall. The results are shown in Figure-3.10.

The runoff coefficient was determined to estimate roughly the long term hydrological water balance. If there was no rainfall at all for a long enough period, there would be no base flow. Therefore, the regression line of the discharge and rainfall correlation has to pass through the origin.





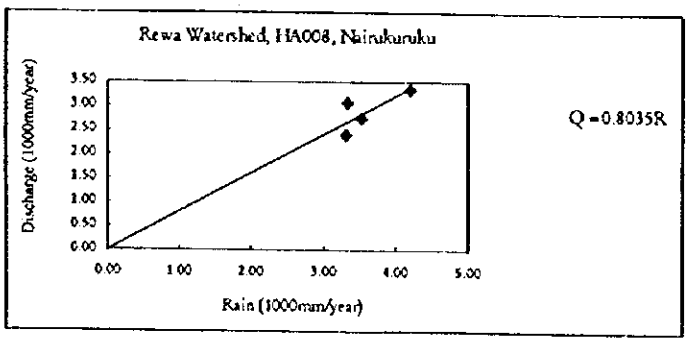
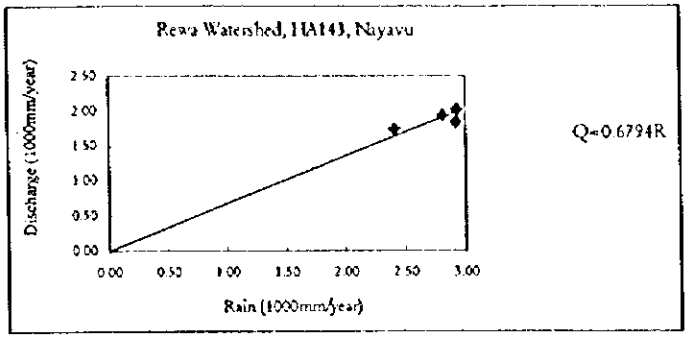
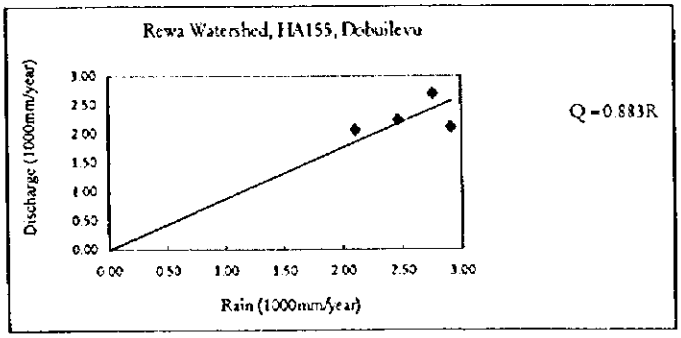
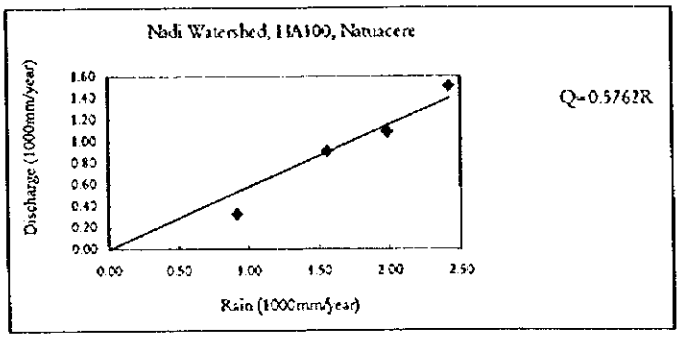
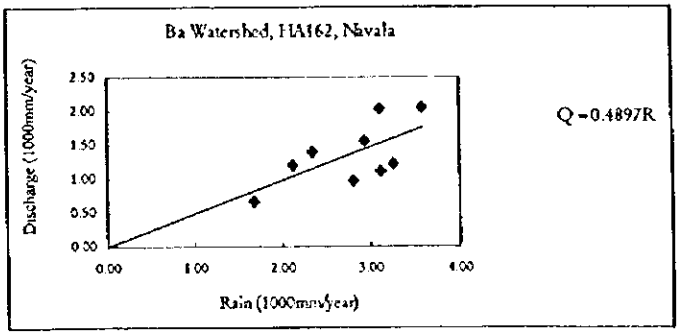


Figure-3.10 (1/2) Total Runoff Coefficient









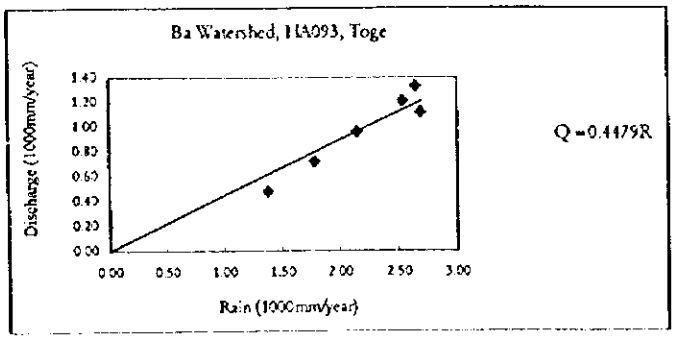


Figure-3.10 (2/2) Total Runoff Coefficient

Total runoff coefficient for a year varies between 0.45 and 0.88 depending on location. In general, runoff coefficient is a function of topography, vegetation and rainfall intensity. Therefore, it depends on the individual flood. However, the total runoff coefficient for a year is the average value of all these factors. In addition, the total runoff coefficients presented here are approximations due to the limited data.

Annual ET_p (reference crop evapotranspiration or potential evapotranspiration) in the western side of Viti Levu is approximately 2,000 mm, while one in the eastern side is 1,500 mm. Since ET_p is the maximum evapotranspiration, the actual value is lower than ET_p. Annual rainfalls in the western and eastern side are about 2,000 and 3,000 mm, respectively. If actual value of evapotranspiration was assumed 50 % of Et_p and recharge to groundwater was small enough to be ignored, the total runoff coefficient computed would be reasonable.

(3) Flow Capacity of 4 Major Viti Levu Rivers

Flow capacity of river channel was examined by computation of non uniform flow. The sections examined are those at which the river profile and cross section survey was conducted.

Rewa River	50 km from river mouth with 500 m interval
Sigatoka River	50 km from river mouth with 500 m interval
Nadi River	25 km from river mouth with 500 m interval
Ba River	35 km from river mouth with 500 m interval

Explanation of the model and discussion of the results are described in Chapter 6.

3.5.2 High Water

Hydrograph analysis using the storage function was employed to analyze the High Water. The details of the model and discussion of the results are described in Chapter 6.

Literature Cited

Doorenbos, J., and Pruitt, W.O. (1977). Guidelines of Predicting Crop Water Requirements. FAO Irrigation and Drainage Paper 24. Food and Agriculture Organization of the United Nations. Rome.

CHAPTER 4 SOCIO-ECONOMY

4.1 Present Situation

4.1.1 National Socio-Economic Background

(1) Administration

Fiji is divided into four administrative divisions, namely, Central, Western, Northern and Eastern. Each of the four Divisions has a Commissioner who is the administrative head of the government operation in the Division. The division is divided into several Provinces which consist of 15 units in the country as a whole. Further, the respective provinces are also divided into Tikina (District) ranging from 2 to 14 units. The administrative least unit is a Village (Community or Locality) and there are between 1 and 75 units per Tikina.

Local governments fall under the jurisdiction of the Central Government, which is composed of the following 3 Offices and 18 Ministries (as of August 8,1997);

Office of the President

Office of the Prime Minister

Office of the Attorney-General

Ministry with Special Responsibility for the Constitution

Ministry of Justice and Home Affairs

Ministry of National Planning

Ministry of Finance

Ministry of Agriculture, Fisheries and Forests

Ministry of Regional Development and Multi-Ethnic Affairs

Ministry of Foreign Affairs and External Trade

Ministry of Tourism and Transport

Ministry of Education and Technology

Ministry of Lands and Mining Resources

Ministry of Local Government, Housing and Environment

Ministry of Fijian Affairs and ALTA

Ministry of Youth, Employment Opportunities and Sports

Ministry of Communication, Works, and Energy

Ministry of Health

Ministry of Information, Women and Culture

Ministry of Labor and Industrial Relations

Ministry of Commerce, Industry, Co-operatives and Public Enterprises

(2) Population

1) Population Census

The Fiji's population constitutes of two major groups, the indigenous Melanesian population, subsequently referred to as Fijians, and the population who are of Indian descent, referred to as Indians. Apart from Fijians and Indians, there are Europeans, Part-Europeans, Chinese and Other Pacific Islanders, who form small proportions. Christianity (Wesleyan) is the dominant religion among Fijian people and those from Indian subcontinent are mostly followers of Hinduism and Islam.

The population censuses of Fiji have been conducted twelve times since 1881 and the historic changes of population since the 1956 census are provided in Table-4.1. The population of Fiji reached 772,655 in 1996 rising by 426,918 (about 223 %) from the 1956 census population of 345,737. For the period from 1986 to 1996, the annual growth rate was 0.8 % which was the lowest of the historic intercensal growth rate since 1956. In the 1996 Census, Fijians and Indians recorded the populations of 394,999 and 336,579 or 51.1 % and 43.6 % of the total population, respectively.

Table-4.1 Population by Ethnic Origin and Sex Group in Successive Censuses, 1956 ~ 1996

Ethnic Origin	Sex	Population (Person)					Average Annual Growth Rate (%)			
		1956	1966	1976	1986	1996	1956-66	1966-76	1976-86	1986-96
Chinese	Male	2,624	2,910	2,503	2,546		1.0	-1.5	0.2	
	Female	1,531	2,239	2,149	2,238		3.9	-0.4	0.4	
	Total	4,155	5,149	4,652	4,784		2.2	0.0	0.3	
European	Male	3,374	3,427	2,605	2,240		0.2	-2.7	-1.7	
	Female	3,028	3,163	2,324	1,956		0.4	-3.0	-1.7	
	Total	6,402	6,590	4,929	4,196		0.3	-2.9	-1.6	
Fijian	Male	74,989	102,479	131,413	167,256		3.2	2.5	2.4	
	Female	73,145	99,697	128,519	162,049		3.2	2.6	2.4	
	Total	148,134	202,176	259,932	329,305	394,999	3.2	2.5	2.4	1.8
Indian	Male	88,359	122,632	147,194	175,829		3.3	1.8	1.8	
	Female	88,359	122,632	147,194	175,829		3.3	1.8	1.8	
	Total	169,403	240,960	292,896	348,704	336,579	3.6	2.0	1.8	-0.4
Part-European	Male	4,008	4,951	5,358	5,396		2.1	0.8	0.1	
	Female	3,802	4,736	4,918	4,901		2.2	0.6	0.0	
	Total	7,810	9,687	10,276	10,297		2.2	0.6	0.0	
Rotuman	Male	2,232	2,932	3,666	4,387		2.8	2.2	1.8	
	Female	2,190	2,858	3,625	4,265		2.7	2.4	1.6	
	Total	4,422	5,797	7,291	8,652		2.7	2.3	1.7	
Other Islanders	Male	2,839	3,207	3,474	4,499		1.2	0.8	2.6	
	Female	2,481	2,888	3,348	4,128		1.5	1.5	2.1	
	Total	5,320	6,095	6,822	8,627		1.4	1.1	2.4	
All Others	Male	50	202	737	415		15.0	13.8	-5.6	
	Female	41	71	533	395		5.6	22.3	-3.0	
	Total	91	273	1,270	810		11.6	16.6	-4.4	
Other than Fijians and Indians						41,077			1.0	
Total	Male	178,479	242,747	296,950	362,568		3.1	2.0	2.0	
	Female	167,262	233,980	291,118	352,407		3.4	2.2	1.9	
	Total	345,737	476,727	588,068	715,375	772,655	3.3	2.1	2.0	0.8

Source: Bureau of Statistics, 1989[1] and Bureau of Statistics, 1997[1]

Table-4.2 presents a divisional distribution of the population as of 1996. Among the four Divisions, the Central Division had the largest population of 297,255 or 38.5 % of the total population. Following the Central, the Western Division had a population of 295,891 or 38.3 %. The Central Division has many of Fijians and other ethics except Indians, while in the Western Division Indians account for larger number of population.

In 1996, the urban population in Fiji amounted to 358,131 with the annual growth rate of 2.6 % during the period 1986 ~ 1996, of which the Fijian population recorded a high growth rate of 4.1 % per annum. The urban population accounted for 45.2 % of Fiji's population in 1996, as against 38.9 % in 1986. The ethnic distribution of the urban population in 1996 was 45.2 % for Fijians, 46.6 % for Indians and 8.2 % for Others (Table-4.3).

The main features of the 1996 Census result are;

- Declining growth rates overall and lowest growth rate among censuses since 1901 Census
- Dramatic change in ethnic composition of total population,
- Decrease in the overall number of the Indian people due to a large fall in the rural population,
- Intensified urbanization, especially by Fijians,
- Decrease in rural proportion due to heavy Indian leave and a small increase of Fijian.

Table-4.2 Population of Division by Ethnic Origin (1996 Census)

Division	Fijians		Indians		Others		Total	
	Number	%	Number	%	Number	%	Number	%
Central	176,842	44.8	97,970	29.1	22,443	54.6	297,255	38.5
Western	116,704	29.5	171,803	51.0	7,384	18.0	295,891	38.3
Northern	65,023	16.5	66,205	19.7	7,526	18.3	138,754	18.0
Eastern	36,430	9.2	601	0.2	3,724	9.1	40,755	5.3
Total	394,999	100.0	336,579	100.0	41,077	100.0	772,655	100.0

Source: Bureau of Statistics, 1997[1)]

Table-4.3 Population Distribution by Urban and Rural Areas

Urban/Rural		Fijians		Indians		Others		Total	
		Number	(%)	Number	(%)	Number	(%)	Number	(%)
1. Urban	1986	107,780	38.9	144,533	52.2	24,712	8.9	277,025	100
	1996	161,824	45.2	166,851	46.6	29,456	8.2	358,131	100
	Annual Growth Rate (%)		4.1		1.4		1.8		2.6
2. Rural	1986	221,525	50.5	204,171	46.6	12,654	2.9	438,350	100
	1996	233,175	56.3	169,728	40.9	11,621	2.8	414,524	100
	Annual Growth Rate (%)		0.5		-1.8		-0.8		-0.6
3. Total	1986	329,305	46.0	348,704	48.7	37,366	5.2	715,375	100.0
	1996	394,999	51.1	336,579	43.6	41,077	5.3	772,655	100.0
	Annual Growth Rate (%)		1.8		-0.4		1.0		0.8
4. Share to Ethnic Total (%)	Urban (1986)		32.7		41.4		66.1		38.7
	Rural (1986)		67.3		58.6		33.9		61.3
	Urban (1996)		41.0		49.6		71.7		46.4
	Rural (1996)		59.0		50.4		28.3		53.6
5. Share to Total Population (%)	Urban (1986)		15.1		20.2		3.5		38.7
	Rural (1986)		31.0		28.5		1.8		61.3
	Urban (1996)		20.9		21.6		3.8		46.4
	Rural (1996)		30.2		22.0		1.5		53.6

Source: Bureau of Statistics, 1997[1]

2) Labor Force

Of the total labor force estimated to be 274,700 in 1994, a total of 258,200 were in some form of employment. As for the labor forces of Fiji from 1984 to 1994, the whole picture had showed comparatively moderate and stable movement. The ration of labor force to the total population was 32.6 % in 1984 and moved up to 34.9 % in 1994. The unemployment rate had remained within a range from 5.4 % to 6.4 % during 1989 to 1994. Meanwhile, the labor force composition of male and female were 81.0 % and 19.0 % respectively in 1984, and 78.8 % and 21.2 % in 1994. The average annual growth rate of male and female labor force during 1984 and 1994 were 1.7 % and 3.1 % respectively. A significant increase of female participation seems to have taken place in the middle of 1980's (refer to Table-4.4).

Table-4.4 Labor Force

Unit: 1,000 persons

	Labor Force						Unemployed (Both Sexes)		Total Population	Labor Force to Total Population (%)
	Number			Percentage			Number	%		
	Male	Female	Both Sexes	Male	Female	Both Sexes				
1984	182.2	42.8	225.0	81.0	19.0	100.0	16.8	7.5	691	32.6
1985	186.3	43.7	230.0	81.0	19.0	100.0	18.6	8.1	702	32.8
1986	189.9	51.2	241.1	78.8	21.2	100.0	20.1	8.3	715	33.8
1987	194.7	52.5	247.2	78.8	21.2	100.0	25.2	10.2	721	34.3
1988	199.1	53.6	252.7	78.8	21.2	100.0	28.0	11.1	724	34.9
1989	194.6	52.4	247.0	78.8	21.2	100.0	15.0	6.1	726	34.0
1990	199.0	53.6	252.6	78.8	21.2	100.0	16.0	6.4	736	34.3
1991	203.3	54.8	258.1	78.8	21.2	100.0	15.2	5.9	746	34.6
1992	207.6	56.0	263.6	78.8	21.2	100.0	15.8	5.4	758	34.8
1993	211.8	57.1	268.9	78.8	21.2	100.0	15.8	5.9	771	34.9
1994	216.4	58.3	274.7	78.8	21.2	100.0	16.5	6.0	784	35.0

Source: Bureau of Statistics (1985 ~ 1995)

Table-4.5 presents a distribution of the total employment and paid employment by sector during period from 1988 to 1992. The overwhelming majority of 63 % to total employment were own account or unpaid family workers, most of whom were in agricultural sector. Fiji's economy is largely based on agro-economy and the agricultural sector actually comprised the dominant share, service sector shared 10.9 % and manufacturing sector was 8.5 % in 1992. Meanwhile, construction, manufacturing and electricity sectors had showed considerable increase of 12.5 %, 10.8 % and 10.1 % at the average annual growth rate respectively between 1988 and 1992.

Table-4.5 Total Employment and Paid Employees by Sector

Unit: person

	1988	1989	1990	1991	1992	Share in 1992 (%)	Annual Average Growth Rate (%)
Agriculture	2,004	2,130	2,312	2,583	2,248	0.9	2.9
Mining	1,526	1,621	1,402	1,120	1,418	0.6	-1.8
Manufacturing	14,040	19,666	21,051	23,400	21,181	8.5	10.8
Electricity	1,858	2,017	2,543	2,712	2,727	1.1	10.1
Construction	5,304	5,227	5,727	7,031	8,480	3.4	12.5
Distribution, Hotels	11,864	14,330	14,848	14,536	13,622	5.5	3.5
Transport	8,048	9,852	9,520	8,950	9,731	3.9	4.9
Finance	5,071	5,823	5,633	5,855	5,816	2.3	3.5
Services	27,814	29,210	25,915	25,349	27,257	10.9	-0.5
Total Paid Employment	77,529	89,876	88,952	91,536	92,480	37.1	4.5
Own Account, unpaid family workers, other employees	148,400	142,800	147,400	151,400	156,900	62.9	1.4
Total Employment	225,900	232,700	236,400	242,900	249,400	100.0	2.5

Source: Government of Republic of Fiji, 1993

(3) Gross Domestic Product (GDP)

The GDP of Fiji at current prices reached F$ 2,338 million in 1994, increasing at an average annual gross rate of 7.1 % from 1990 to 1994. The GDP per capita at current prices also increased from F$ 2,474 to F$ 3,002 at an average annual growth rate of 5.5 % during the same period. Meanwhile, the GDP at 1977 constant price amounted to from F$ 849 million in 1990 to F$ 937 million in 1994, increasing at the average annual growth rate of 2.7 % during the same period. And the per capita GDP at the 1977 constant prices increased from F$ 1,160 in 1990 to F$ 1,203 in 1994, at the average annual growth rate of 1.2 % (refer to Table- 4.6).

Table-4.6 Gross Domestic Product (GDP)

Items		1990	1991	1992	1993	1994	Average Annual Growth Rate (%)
A. at the Current Prices	GDP(F$ Million)	1,811	1,938	2,098	2,224	2,338	
	Annual Growth Rate (%)	(9.0)	(7.0)	(8.3)	(6.0)	(5.1)	(7.1)
	Per Capita GDP (F$)	2,474	2,605	2,787	2,907	3,002	
	Annual Growth Rate (%)	(7.8)	(5.3)	(7.0)	(4.3)	(3.3)	(5.5)
B. at the 1977 Constant Prices	GDP (F$ Million)	849	854	881	897	937	
	Annual Growth Rate (%)	(3.5)	(0.5)	(3.2)	(1.8)	(4.5)	(2.7)
	Per Capita GDP (F$)	1,160	1,148	1,170	1,172	1,203	
	Annual Growth Rate (%)	(2.4)	(-1.1)	(1.9)	(0.2)	(2.6)	(1.2)

Source: Bureau of Statistics, 1996

Table-4.7 of the gross domestic products at 1977 constant prices by industries showed that the respective share of the primary and secondary industry was kept stable, and that of the tertiary industry was in progress. The annual growth showed ups and downs but the average growth rate during the period of 1987 ~ 1994 was 4.1 %.

Agriculture, including forestry and fisheries, which is major contributing sector to GDP in Fiji, accounted for around 20 % of the total GDP during the period from 1987 to 1994. The average annual growth rate was 2.7 % in real base during same period. Of the agriculture sector, sugarcane production has made the greatest contribution to the stable economic growth. In terms of GDP, the sugarcane production accounted for about 40 % of agricultural production during the period from 1987 to 1994. In Fiji, tourism is also an important sector with high economic growth. Hotel, restaurant and café industries related to tourism accounted for high share of GDP, 3.6 % of the total GDP in 1994. The average growth rate of value added by these tourism related industries was as high as 7.8 % in real base per annum during the period of 1987 ~ 1994.

Table-4.7 Gross Domestic Product (GDP) at 1977 Constant Prices by Industries

Industries	GDP by Industries (F$ 1,000)								
	1987	1988	1989	1990	1991	1992	1993	1994	Average
1. Primary Industry	175,040	171,865	191,453	183,699	180,624	186,576	192,861	208,996	
(share, %)	(25)	(24)	(23)	(22)	(21)	(21)	(22)	(22)	(22.4)
2. Secondary Industry	121,884	121,949	138,386	139,458	148,832	157,164	149,965	162,300	
(share, %)	(17)	(17)	(17)	(16)	(17)	(18)	(17)	(17)	(17.1)
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	436,543	455,588	514,995	554,815	533,096	567,034	585,006	598,311	
(share, %)	(61)	(63)	(63)	(65)	(62)	(64)	(65)	(64)	(63.5)
4. Imputed Service Charges	-21,953	-22,634	-24,352	-28,596	-27,744	-29,843	-31,096	-32,679	
(share, %)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3.3)
All Activities	711,514	726,768	820,482	849,376	853,808	880,931	896,736	936,928	
(share, %)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	
Annual Growth Rate of GDP (%)									
1. Primary Industry	–	-1.8	11.4	-4.1	-1.7	3.3	3.4	8.4	2.7
2. Secondary Industry	–	0.1	13.5	0.8	6.7	5.6	-4.6	8.2	4.3
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	–	4.4	13.0	7.7	-3.9	6.4	3.2	2.3	4.7
4. Imputed Service Charges	–	3.1	7.6	17.4	-3.0	7.6	4.2	5.1	6.0
All Activities	–	2.1	12.9	3.5	0.5	3.2	1.8	4.5	4.1

Source: Bureau of Statistics, 1996

(4) Industries

1) Agriculture and Agro-industry

Major agricultural products of Fiji are sugarcane, copra, paddy rice, chicken and eggs. The processed agricultural products are represented by sugar, coconut oil, flour, butter, cigarettes and stock feed.

Sugarcane and sugar are the most important agricultural products. The sugarcane production in Fiji rose at an average annual rate of 5.0 % during the period from 1991 to 1995, and in 1995 the production reached 4.1 million tones with its harvested area of 74,000 hectares and the yield of 55 ton/ha. In 1995, the input of sugarcane per ton of sugar showed 9.1 tones which was somehow higher compared to 8.7 tones in 1991. Meanwhile, sugar production rose at an average annual growth rate of 3.9 %. As a result, the 1995 production of sugar amounted to 454,000 tones, an increase of 65,000 tones compared to the 1991 production (refer to Table-4.8).

Table-4.8 Production and Price of Sugar Industry

Items		Unit	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
1. Sugarcane	Number of Contract		22,479	23,334	23,454	22,808	22,414	-0.1
	Area Harvested	1,000 ha	72	73	74	74	74	0.1
	Production	1,000 ton	3,380	3,533	3,704	4,064	4,110	5.0
	Average Production per ha	ton	47	49	50	53	55	4.3
	Prices paid to Growers	F$/ton	51	55	49	51	54	1.3
	Input of Cane per ton of Sugar	ton	9	8	8	8	9	0.9
2. Sugar	Sugar Production	1,000 ton	389	426	442	517	454	3.9
	Molasses Production	1,000 ton	138	129	136	155	181	7.0
	Export of Sugar							
	Quantity	1,000 ton	357	365	439	471	445	5.7
	Value(FOB)	F$ 1,000	220,400	221,281	230,688	252,183	276,112	5.8
	Unit Value	F$/ton	617	607	525	535	620	0.1

Source: Bureau of Statistics, 1996

2) Manufacturing Industry

Major products of manufacturing industries in Fiji are gold, silver, cement, beer, paint, soap, soft drinks. Production of silver, cement and soft drinks showed considerably high increase rate of 34.7 %, 3.6 % and 5.0 % per annum respectively during the period of 1991-1995. Gold is one of the significant traditional products of Fiji, and its production increased at an average annual rate of 6.1 % during the same period (refer to Table-4.9).

Table-4.9 Production of Selected Manufactured Products

Products	Units	Production					Average Annual Growth Rate (%)
		1991	1992	1993	1994	1995	
1. Gold	kg	2,743	3,701	3,784	3,440	3,477	6.1
2. Silver	kg	477	1,258	1,112	1,386	1,572	34.7
3. Cement	1,000 ton	79	84	80	94	91	3.6
4. Beer	mega liter	18	17	17	16	15	-4.5
5. Paints	1,000 liter	2,339	2,535	2,795	2,626	2,363	0.3
6. Soap	ton	7,068	6,891	7,002	7,248	7,070	0
7. Matches	1,000 Gross Box	147	142	145	162	167	3.2
8. Electricity	million kwh	474	470	480	520	544	3.5
9. Ice Cream	1,000 liter	2,450	2,479	2,772	2,930	2,755	3.0
10. Soft Drinks	1,000 liter	8,186	9,173	10,292	8,962	9,941	5.0
11. Toilet Paper	1,000 roll	9,676	9,780	9,719	11,543	11,190	3.7

Source: Bureau of Statistics, 1996

3) Tourism

Together with the sugar industry, tourism is one of the most important industries of Fiji for earning foreign currencies. In 1995, visitor arrivals in Fiji were 318,494, of which 80 % were on vacation. During the period from 1991 to 1995, the arrivals increased at the annual rate of 5.3 % on average (Table-4.10). Of these tourist, 24.6 % were Australians, 18.5 % New Zealanders, 14.2 % Japanese, 12.5 % Americans and 7.7 % British in 1995.

Table-4.10 Visitor Arrival by Purpose of Visit

Unit: person

Purpose of Visit	1991	1992	1993	1994	1995	Share in 1995 (%)	Average Annual Growth Rate (%)
Business	12,524	13,442	15,685	17,729	16,570	5.2	7.2
Conference	5,589	5,280	5,038	6,412	7,279	2.3	6.8
Holiday	209,146	228,715	233,081	256,425	255,973	80.4	5.1
Visiting Friends/Relatives	14,146	16,997	16,912	19,619	21,487	6.7	11.0
Education/Training	2,621	2,727	2,725	3,350	3,660	1.1	8.7
Others	15,324	11,571	14,021	15,339	13,664	4.3	-2.8
Total	259,350	278,534	287,462	318,874	318,494	100.0	5.3
Expenditure(F$ Mil)	286	328	347	393	442		11.5

Source: Bureau of Statistics, 1996

During the period of 1991 ~ 1995, the room and bed capacities of hotels increased at the annual rate of 3.8 % and 2.9 % respectively, with total of 1,880,812 rooms and 4,901,068 beds in 1995. Of these capacities, the occupancies were 1,013,011 of rooms and 1,965,328 of beds, corresponding to 53.9 % and 40.1 % of the respective total capacities in the same year.

(5) Prices

Table-4.11 shows the consumer price index of Fiji for the period from 1993 to 1995. Annual escalation rate for all items recorded 1.4 % on average for the said period, of which the alcoholic drink & tobacco and service sectors showed comparatively high escalation rates of 5.4 % and 3.7 % per annum, respectively. Meanwhile, the inflation rate of Fiji during 1993 ~ 1995 showed 2.7 % on average.

Table-4.11 Consumer Price Index and Inflation Rate

Base Year 1993 = 100

Items	Price Index				Average Annual Rise Rate(%)
	Weight	1993	1994	1995	
Foods	353.6	100.0	100.5	101.2	0.6
Alcoholic Drinks and Tobacco	61.3	100.0	105.9	111.0	5.4
Housing	164.9	100.0	100.6	103.2	1.6
Heating & Lighting	49.0	100.0	99.3	99.5	-0.3
Durable Housing Goods	65.2	100.0	99.8	100.0	0.0
Clothing and Foot Wear	53.9	100.0	99.4	101.4	0.7
Transport	128.5	100.0	100.7	105.4	2.0
Services	75.8	100.0	103.0	107.7	3.6
Miscellaneous	47.8	100.0	99.5	101.0	0.5
All Items	1,000	100.0	100.8	103.0	1.4
Average Annual Inflation Rate (%)		5.2	0.6	2.2	

Source: Bureau of Statistics, 1996

(6) External Trade and Payments

1) Export

In 1995, Fiji's exports amounted to F$ 869.9 million, of which domestic exports and re-exports were F$ 764.5 million and F$ 105.5 million, respectively. During the period of 1991 ~ 1995, the annual growth rate showed 7.1 % on average (refer to Table-4.12).

Table-4.12 External Trade

Unit: F$ 1,000

Items	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
Export	664,599	666,971	692,402	800,495	869,941	7.0
Domestic	554,785	554,778	588,389	657,041	764,481	8.3
Re-Export	109,814	112,198	104,013	143,454	105,460	-0.1
Import	961,767	947,110	1,109,807	1,209,852	1,218,934	6.1
Trade Balance	-297,168	-280,134	-417,405	-409,357	-348,993	

Source: Bureau of Statistics, 1996

Principal commodities of domestic export are sugar, fish, molasses, cork & wood, garment and gold. Export of sugar, which ranked first and had a share of 37.8 % in value to the total domestic export commodities, amounted to F$ 276.1 million in 1995 with an increase by F$ 23.9 million compared with the 1994 export, but its quantity in 1995 decreased 26,000 tones compared to that in 1994. Following sugar, garments and gold ranked second and third, respectively, with value of F$ 185.0 million and F$ 58.6 million in 1995.

2) Import

Fiji's imports amounted to F$ 1,218.9 million in 1995 on the increase at an average annual rate of 6.1 % since 1991. Major import commodities of Fiji are manufactured goods, machinery, foods, mineral fuel, chemicals, etc. Among them, manufactured goods and machinery showed F$ 337.0 million and F$ 278.0 million, respectively, or the proportion to the total imports was about 27.6 % and 22.8 %. The average annual

growth rate of imports were 6.1 % for total commodities, 8.2 % for manufactured goods and 6.5 % for machinery, during the period of 1991 ~ 1995.

3) Balance of External Trade and Payments

External trade balance of Fiji showed a deficit every year during the period of 1991 ~ 1995. The trade deficit amount per annum was F$ 351 million on average. However, the trade deficit has been mostly compensated by services account of tourism and others. Nevertheless, the overall balance showed a deficit in 1993 through 1994, due to the unfavorable balance of accounts of investments and private transfers (refer to Table-4.13).

Table-4.13 Balance of External Payment

Unit: F$ million

Items	1991	1992	1993	1994	1995
Good and Service (net)	-45.5	-27.0	-152.9	-55.5	-63.1
Factor Services (net)	-58.5	-75.2	-83.6	-126.1	-104.9
Private Transfers (net)	-36.3	-24.5	-17.1	-34.8	-37.2
Government Transfers (net)	142.1	141.9	123.6	105.4	149.7
Current Account Balance	1.8	15.2	-130.0	-111.0	-55.5
Capital (excluding Reserves)	-26.4	88.2	20.7	41.1	106.2
Errors and Omissions	37.3	-14.3	38.9	53.3	58.2
Overall Balance	12.7	89.1	-70.4	-16.6	108.9

Note: Factor Services includes investment income.
Source: Ministry of Finance and Economic Development (1996. 11)

(7) Government Finance - Revenue and Expenditure

1) Central Government

The 1992 Budget announced changes to compensate income tax payers for the introduction of VAT, which became effective on 1st July, 1992. The changes raised the tax threshold significantly, abolished basic tax, aligned company tax with the top personal tax rate and reduced the number of tax bands.

In 1995, the revenue and expenditure of the Central Government amounted to F$ 718.9 million and F$ 809.1 million on the increase at an average annual growth rates of 5.7 % and 5.3 % respectively, during the period of 1991 ~ 1995.

Table-4.14 Current Revenue and Expenditure of Central Government

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995
Revenue	574,970.5	602,306.1	654,086.8	697,810.7	718,904.2
General Revenue	562,517.8	588,809.1	645,773.1	689,022.8	705,987.9
Capital Revenue	12,452.7	13,497.0	8,313.7	8,787.9	12,916.3
Expenditure	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5
Operating Expenditure	550,678.7	602,059.5	688,703.2	663,975.4	688,674.0
Capital Expenditure	107,771.1	95,108.7	94,450.3	106,687.5	86,020.3
VAT		16,670.3	35,638.4	33,398.5	34,418.2
Balance	-83,479.3	-111,532.4	-164,705.1	-106,250.7	-90,208.3

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

The revenue is represented by two major components; 1) customs, and port and harbor dues, and 2) income tax, estate and gift duties and Value Added Tax (VAT). In 1995, the revenue from the former amounted to F$ 207.8 million (28.9 % of the total revenue). The latter revenue amounted to F$ 395.1 million (55.0 % of the total revenue). The annual increase rates of both revenues were -1.5 % and 14.6 % respectively, during the period of 1991 ~ 1995. The grant aid from overseas donors is an important revenue source for financing various capital investment by the Government.

Table-4.15 Breakdown of Central Government Revenue

(Unit: F$ 1,000)

Heads of Revenue	1991	1992	1993	1994	1995
REVENUE	574,970.5	602,306.1	654,086.8	697,810.7	718,904.2
General Revenue	562,517.8	588,809.1	645,773.1	689,022.8	705,987.9
- Customs, Port and Harbour Dues, etc.	220,483.1	198,733.5	179,435.9	190,785.5	207,838.9
- Income Tax, Estate and Gift Duty, VAT	229,205.1	284,369.4	348,567.5	375,522.3	395,081.6
- Licences, Fees, Royalties, Sales and Reinbursement	60,238.2	57,548.4	64,077.4	58,608.1	56,942.0
- Others	52,591.4	48,157.8	53,692.3	64,106.9	46,125.4
Capital Revenue	12,452.7	13,497.0	8,313.7	8,787.9	12,916.3
- Grant Aid	7,303.7	7,189.5	4,114.8	4,458.8	6,274.2
- Others	5,149.0	6,307.5	4,198.9	4,329.1	6,642.1

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

The expenditure of Central Government consists mainly of departmental expenditure and public debt charge. In 1995, these expenditures were F$ 566.0 million and F$ 161.5 million which accounted for 70.0 % and 20.0 % of the total expenditure, respectively. During the period of 1991-1995, the annual increase of them were 4.2 % and 4.3 %, respectively.

Table-4.16 Breakdown of Central Government Expenditure

(Unit: F$ 1,000)

Heads of Revenue	1991	1992	1993	1994	1995
EXPENDITURE	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5
Departmental Expenditure	479,539.7	529,237.1	584,125.3	580,191.2	566,018.8
Miscellaneous Services	19,237.6	18,552.9	19,467.6	17,467.7	17,585.8
Pension Gratuities and Compassionate Allowances	23,330.0	25,833.8	26,591.0	28,903.0	29,559.6
Public Debt Charge	136,342.5	123,544.4	152,969.6	144,101.0	161,530.1
VAT		16,670.3	35,638.4	33,398.5	34,418.2

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

2) Expenditure by Functional Categories

Table-4.20 shows the expenditure by functional categories. The capital expenditure of Government averaged F$ 98.0 million in the period of 1991-1995. The averages of capital expenditure for infrastructure development were 40.9 million.

Table-4.17 Expenditure by Functional Categories

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995	Average
Government Total						
Operating Expenditure	550,678.7	602,059.5	688,703.2	663,975.4	688,674.0	-
Capital Expenditure	107,771.1	95,108.7	94,450.3	106,687.5	86,020.3	98,007.6
VAT		16,670.3	35,638.4	33,398.5	34,418.2	-
total	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5	-
of which						
Infrastructure						
Operating Expenditure	56,765.9	67,527.3	73,235.2	63,878.5	61,278.1	-
Capital Expenditure	30,093.1	28,925.3	48,288.9	50,093.7	47,085.3	40,897.3
VAT		4,613.3	9,332.0	9,557.7	9,733.2	-
total	86,859.0	101,065.9	130,856.1	123,529.9	118,096.6	-
of which						
MIPW inclusive Marine Dept. and Road Transport Dept.						
Operating Expenditure	43,676.0	48,446.4	56,779.9	48,627.1	46,025.6	-
Capital Expenditure	27,986.0	27,035.2	45,818.6	47,244.8	45,579.9	38,732.9
VAT		4,070.3	8,331.7	8,539.2	8,569.4	-
total	71,662.0	79,551.9	110,930.2	104,411.1	100,174.9	-
MAFFA inclusive Dept. of Forests						
Operating Expenditure	19,298.1	20,713.6	27,523.4	22,659.4	22,859.9	-
Capital Expenditure	16,482.7	15,826.4	5,120.8	9,627.2	6,659.9	10,743.4
VAT		1,908.2	2,697.7	2,577.9	2,449.8	-
total	35,780.8	38,448.2	35,341.9	34,864.5	31,969.6	-

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

3) Overseas Assistance and Loans

Table-4.18 shows the flow of the foreign grant aid and loan disbursement to the Government. In 1995, the amount of grant aid and overseas loan was F$ 27.4 million in total.

Table-4.18 Foreign Aid

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995	Average
A. Grant Aid (Capital Receipt)	7,303.7	7,189.5	4,114.8	4,458.8	6,274.2	5,868.2
B. Overseas Loans	21,597.9	11,302.1	11,825.0	31,054.1	21,137.7	19,383.4
C. Domestic Loans	50,624.1	61,950.6	61,950.6	83,626.4	101,003.2	71,831.0
- Overseas Assistance (A+B)	28,901.6	18,491.6	15,939.8	35,512.9	27,411.9	25,251.6
- Total Loan (B+C)	72,222.0	73,252.7	73,775.6	114,680.5	122,140.9	91,214.3

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

(8) Transport and Communication

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), current conditions on transport and communication are described as follows.

1) Roads

In 1986, the total road length of Fiji amounted to 4,839 km consisting of 1,302 km of main roads, 643 km of secondary roads, 2,678 km of residential roads and 106 km of other roads. In the Viti Levu island, the main roads are represented by Kings Road and Queens Road, which are 486 km in length and run the circumstance of the island. The road distribution in the country uniforms comparatively; 1,525 km in the Central and Eastern Division, 1,676 km in the Western Division and 1,638 km in the Northern Division.

The public investment for the road network shows its expansion from around 2,600 km in 1970 to around 4,800 km in the mid 1980's. Since then the emphasis has shifted from extension of network to maintenance of existing roads. The road network now totals around 5,100 km of which 1,030 km are sealed. Viti Levu and Valua Levu account for 90 percent of the total network and Viti Levu accounts for 90 percent of the sealed roads.

Meanwhile, since 1983 there have been a number of major road projects undertaken;

- Fiji Road Upgrading Project (FRUP) Stage 1: The project started in 1987 and 121.2 km road upgraded and 24 new bridges constructed. The F$ 59 million project was co-funded by the World Bank and Fiji government.
- Road Maintenance Sector Project: Under this project, the rehabilitation and maintenance works were carried out on main roads, rural roads and major bridges.

A National Road Safety Council (NRSC) as a statutory authority was formed in 1995 with responsibility for overall coordination of road safety activities in Fiji.

2) Shipping

Since Fiji comprises more than 300 islands, shipping is a vital means of transport for people living in the outlying areas. The inter-island shipping fleet is a mix of private and government vessels. Larger roll-on roll-off ferries have been introduced on the busier routes, and there has been a reduction in the number of private operators involved in the industry.

The Port Authority of Fiji administers three international ports; Suva, Lautoka and Levuka. Major redevelopment of the Port of Suva and Lautoka has been completed. Suva and Lautoka have wharf facilities with the capacities to cargo vessels and the largest cruise liners. Lautoka port has bulk handling facilities for sugar and wood chips, and a major upgrading is in progress.

3) Air Services

The international airports are located at Suva and Nadi. The expansion of Nadi airport was implemented with a cost of F$ 10 million in 1987 ~ 88. Nadi, the principal international airport, is owned and operated by the Civil Aviation Authority of Fiji (CAAF). The CAAF is also contracted by Government to operate other domestic airports. Air Pacific (78 % government owned) is the center of the international air services. In the domestic arena, there are several airlines serving in Fiji.

4) Telecommunications

Fiji is equipped with both internal and international telecommunications. All major towns have digital telephone exchanges and the islands are linked by cable and satellite to worldwide network. Telex facilities are available over the country and facsimile machines are in wide use.

At the beginning of 1990, the old Telecommunications Department was replaced by Fiji Post and Telecommunications Ltd., a private company wholly owned by the Government. FPTL currently consists of the Telecom Fiji Ltd. and Posts Fiji Ltd.

(9) Energy and Electricity

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), the current situation of energy and electricity in Fiji is summarized as follows.

1) Energy

Fiji's current energy demands are met from numerous of sources including hydro and diesel generated electricity, fuel wood, bagasse, coal and petroleum products. In 1992, Fiji imported F$ 133 million worth of petroleum which amounted to about 6 % of the GDP. In 1992, transport sector accounted for 68 % of the fuel consumption. The industrial sector used up 18 %, domestic 9 % and the Government 5 %.

Fiji continues to seek alternative sources of energy to supplement its large import bill. The Department of Energy is continuing investigations to assess the economic viability of renewable energy sources, such as wind, geothermal and hydro power. Solar lighting systems are being promoted for rural electrification.

2) Electricity

At present, electricity in Fiji is supplied for more than 50 % of the total number of household; 75 % of urban households and 30 % of rural households. The Fiji Electricity Authority (FEA), which was established in 1966 under the Electricity Act of Fiji, provides nearly 95 % of the whole power supply in Fiji. FEA is responsible for generation, transmission and distribution of electricity in Fiji. FEA's responsibilities extend to the administration of technical and safety regulations. FEA operates six separate supply systems of which the hydro based Viti Levu Interconnected System (VLIS) is the largest, accounting for more than 90 % of the total FEA sales.

The Monasavu hydro-electricity project opened in 1983, is the largest energy diversification project undertaken in Fiji, resulting in annual saving of F$ 22 million in terms of petroleum import. However, The Monasavu project which generates 95 % of Viti Levu's electricity needs has now reached its maximum generation capacity, requiring diesel backup in times of peak demand. The industrial sector stays as the main consumer of electricity, accounting for more than two-third of total electricity consumption.

Rural electrification (RE) has been given a high priority by the Government. The formation of a RE Unit (REU) is part of the Government's commitment to ensure effective implementation of the policy. The new RE policy is based on a user pays principle with rural consumers paying 10 % of the capital costs and the Government, 90 %. The policy offers consumers the choice of electrification system from diesel, grid connections, solar and hydro.

(10) Water and Sewerage

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), water and sewerage in Fiji are described as follows.

1) Water

Water is one of the nation's most important resources and availability of adequate water supplies is the prerequisite for health of the nation and development activities. About 70 % of the total population have access to proper piped water supplies. The Government funds the development of regional and urban water supplies and also carries out the construction, operation and maintenance of these schemes through the Water and Sewage Division of the Public Works Department. The Government also assists rural communities in developing water supplies through the rural self help scheme, where communities provide one third of cost of materials and free labor. Assistance has been provided in the development of over 1,400 rural water supply scheme since 1965.

The Department of Mineral Resources undertakes hydro-geological investigation designed to identify potential groundwater sources, particularly in outer islands and rural areas of main islands.

2) Sewerage

It is estimated that 12 % of Fiji's population have access to treated sewage facilities, compared to 6 % in 1980. It is also estimated that 57 % of all urban areas have sewerage. Cost recovery is low, with 15 % of annual expenditure (including capital expenditure)

being recovered through charges for sewerage services. Town and city councils were traditionally responsible for sewerage services within their boundaries, but these responsibilities have transferred to the Central Government.

(11) Education and Health

1) Education

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), current status of education and health in Fiji are described as follows.

About a quarter of the entire population is of school-going age and although education is not compulsory at any stage, over 98 % of children between 6 and 14 years of age are attending primary schools. The Education for All by Year 2000 Programme will continue, aiming to phase in compulsory primary education for all by the year 2000.

There is a high degree of community participation in the delivery of education services. Most schools are managed by non-governmental organizations. The Government operates only 2 % of the primary schools, 8 % of the secondary schools, 8 % of vocational and technical education schools, and two out of the five teachers training institutions.

The pupil-teacher ratio at the primary school level is around 1:31 with a lower ratio (1:20) in the rural area and higher ratio (1:42) for the urban area. Many secondary schools are staffed with unqualified teachers. The Fiji College of Advanced Education (FCAE) has been established to rectify this deficiency. The FCAE trains teachers at diploma level for junior secondary teaching. Expansion and improvements of facilities at the FCAE will be incorporated in the education and training investment programme of the Government.

Vocational and technical education is necessary for securing skilled labor. The Fiji Institute of Technology (FIT) is country's main technical education center. What is more, new directions in agro, technical and vocational education will be developed through diversification of school based programme to cater for the lower to medium level of skilled workers, now much demand in Fiji's economy.

Meanwhile, the University of the South Pacific (USP), established in 1968 and located in Suva, is the only regional university in its kind in the world, belonging to 12 Pacific island countries. In the past 25 years, the university has grown, and now has a campus in Western Samoa and centers in ten member countries.

The main components of government policies and strategies in education and training are as follows;

- to ensure the education system to be sensitive to changing needs of the community and economy
- to increase access to education, especially for the rural and urban poor
- to provide a balanced programme of both academic and practical course for the full development of Fiji's youth in rapidly changing society

- to retain the strength inherent in a high level of community participation in education system, while improving efficiency through more effective planning of resource allocation
- to develop vocational and technical education in response to, and to cater for, market demands
- to improve the quality of education by resourcing schools with qualified teachers and materials

2) Health

Fiji generally has a good standard of health. People are living longer with life expectancy of 61.4 years for male and 65.2 years for female. Infant mortality rate has fallen by over 37 % over the last ten years and is now 16.6 deaths per 1,000 live births at present. Good obstetrical services contribute to the lower infant death rate. Effective control has been achieved over childhood infectious diseases. The active immunization program where the coverage rate for 1995 was reported to be 94 % or more. There are 409 village clinics, 100 nursing stations, 74 health centers, 16 sub-divisional hospitals, three divisional hospitals and two specialty hospitals in the country. The ratio of doctor-population as projected in 1992 is 1:2448. Using the 1996 population, the nurse-population ratio is about 1:312.

Main policies and strategies for the development of the health sector are as follows;

- to provide preventive and primary health care, clinical and rehabilitative facilities with adequate manpower resources
- to encourage involvement of local communities in health care
- to ensure attainment of a population growth which is conductive to better standard of living
- to upgrade and strengthen training institutions in an effort to provide a well trained and highly skilled force
- to review the organization of health service delivery to improve efficiency and provide effective incentives

4.1.2 Present Situation of Study and Inundated Area

(1) Area and Population in Study Area

The total area of the four watersheds, namely the Rewa, the Sigatoka, the Nadi and the Ba, is approximately 6,000 km^2. The population of 1996 was calculated by using the latest available tikina figures of 1986 census as the basis and adopting the average annual growth rate of 0.8 % during 1986 and 1996. The population in 1996 was estimated at around 228,000 in the four watersheds, which accounts for 29.5 % of the total population of 772,655. The future population of the watershed was projected and described in the Section 4.2.1.

(2) Area and Population in Inundated Area

1) General

The Flood Damage Survey of the Flood Prone Areas was conducted by JICA Study Team in cooperation with Fiji counterpart personnel, and the questionnaire survey was carried out by a local contractor in the six cites of major Viti Levu rivers in five watersheds, including the Navua watershed. According to the report from the contractor, most sufferers recall the flood incidents of the cyclone Kina of 1993 other than the incidents of, say 1990 and/or 1995 flood.

The questionnaire survey was conducted mainly for the purpose of obtaining the average sample data of income, general assets, agricultural field crops, etc. under the various conditions of inundation, which shall be helpful for the analysis and evaluation of the flood damage of concerned areas. The various figures collected are consolidated and used in the section 6.6.8 of Economic Evaluation of the Projects in Chapter 6.

2) Population and Area

By the leveling survey of flood marks, interview to the district officers and the sufferers in the inundated area of the cyclone Kina in 1993 was estimated at about 21,700 ha in the objective four watersheds. The population in the inundated areas was also estimated by identifying towns and villages in inundated areas on the 1: 50,000 maps, summing up the population of each town and village in 1986 first, and then projecting the population in 1993 with annual growth rate of 0.8 %. As a result, the total population suffered by the cyclone Kina in the objective four watersheds was estimated at 44,500.

4.2 Future Projections

4.2.1 Population Projections

(1) Growth Rate of Population

The growth rate for population projections had been prepared by the Bureau of Statistics based on the different sets of assumptions on fertility, mortality and migration. The growth rates were made by component populations, such as Fijians, Indians and others, under three different variants; High, Medium and Low (refer to Table-4.19).

Table-4.19 Average Annual Growth Rate of Population

(unit: %)

Ethnic Origin and Variant		1996-2001	2001-2006	2006-2011	2011-2016
Fijian	High	1.9	2.0	1.9	1.8
	Medium	1.7	1.6	1.5	1.3
	Low	1.6	1.4	1.3	1.2
Indian	High	0.8	1.3	1.2	1.1
	Medium	0.4	0.2	0.5	0.3
	Low	-0.01	-0.1	-0.1	-0.4
Others	High	2.4	2.3	2.1	1.9
	Medium	0.9	0.9	0.8	0.6
	Low	-0.01	-0.1	-0.1	-0.4
Total	High	1.5	1.7	1.7	1.5
	Medium	1.1	1.2	1.1	0.9
	Low	0.9	0.9	0.7	0.5

Source: Bureau of Statistics, 1997[2)]

(2) Population Projections of Fiji

The population projections were made based on the average annual growth rates given by the Bureau of Statistics, as Scenario A (High Variant), Scenario B (Medium Variant) and Scenario C (Low Variant) from 1996 to 2015, which are shown in the Table-4.20. Since the provisional result of census 1996 provided the Fiji Population by ethnic origin only, (not by male and female), the calculation has been done accordingly.

Table-4.20 Population Projection of Fiji

(persons)

Ethnic Origin	Year	Scenario A High Variant	Scenario B Medium Variant	Scenario C Low Variant
1. Fijians	1996 (Base year)	394,999	394,999	394,999
	2001	433,977	429,735	427,626
	2006	479,146	465,232	458,410
	2011	526,428	501,187	488,992
	2015	565,366	527,761	512,889
2. Indians	1996 (Base year)	336,579	336,579	336,579
	2001	350,259	343,365	336,411
	2006	373,626	346,812	334,732
	2011	351,740	355,569	333,062
	2015	367,474	359,856	327,765
3. Others	1996 (Base year)	41,077	41,077	41,077
	2001	44,252	42,959	42,959
	2006	48,143	44,927	44,927
	2011	52,377	46,753	45,107
	2015	56,425	48,173	46,477
4. Total	1996 (Base year)	772,655	772,655	772,655
	2001	828,488	816,059	806,996
	2006	900,915	856,971	838,070
	2011	930,544	903,510	867,161
	2015	989,264	935,789	887,131

Source: Bureau of Statistics, 1997[1)]
Bureau of Statistics, 1997[2)]

According to these projections, it is estimated that the Fiji's population will be approximately 936,000 in 2015 with an increase of 163,000 since the 1996 population census. The population growth for the period of 1986 ~ 1996 showed relatively low annual growth rates of 0.8 % mainly due to the decline of Indian population by the high rate of emigration coming out from a result of the event in 1987. There may be some opinion that this tendency of low growth shall continue in the future; however, in this Study the medium variant is adopted for the projection from 1996 to 2015 in safety. The population by ethnic origin in 2015 with medium variant will be 1.34 times for Fijians, 1.07 times for Indians and 1.17 times for others, respectively, compared with the figures of 1996.

(3) Population Projections in the Study Area

The Study Area extends over 28 tikinas. The area of the watershed in each tikina was measured and the population density of watershed in each tikina was also estimated. Besides, the population of every tikina in 1986 was given by 1986 census but those of 1996 census were unavailable. Therefore, the 1996 population of tikina was calculated adopting the annual growth rate of 0.8 % during 1986 and 1996. Using those data the population of

the Study Area in 2015 of the High, Medium and Low Variant was estimated by tikina. The result is shown in Table-4.21.

Table-4.21 Estimate of Population in 2015 in the Study Area

Scenario	A (High)	B (Medium)	C (Low)
Population	308,114	279,438	263,045

As shown in Table-4.22, the total population of each watershed in 2015 by medium variant shall reach approximately 279,000 with the increase of 51,000 or 1.22 times from 228,000 in 1996. This total population are composed of 141,000 (50 %) of the Rewa watershed, 32,000 (11 %) of the Sigatoka watershed, 50,000 (18 %) of the Nadi watershed and 57,000 (21 %) of the Ba watershed, respectively.

4.2.2 Projection of Gross Domestic Product (GDP)

(1) Past Trend of Gross Domestic Product (GDP)

Table-4.6 in Section 4.1.1 (3) shows the past trend of GDP at current prices of Fiji which reached F$ 2,338 million in 1994 from F$ 1,811 million in 1990, and the per capita GDP at current prices which increased from F$ 2,474 to F$ 3,002 during the same period. Meanwhile, the GDP at 1977 constant price amounted from F$ 849 million in 1990 to F$ 937 million in 1994 and the per capita GDP at 1977 constant price increased from F$ 1,160 to F$ 1,203 during the same period.

(2) Future Trend of GDP

The figures of Table-4.7 in Section 4.1.1 (3) indicate annual growth rate of GDP and the shares of the activities of the Primary, Secondary, Tertiary Industry and Imputed Service Charges in Fiji.

Using those figures, while taking the fact of limited amount of available past data into consideration, Scenarios of A (High), B (Medium) and C (Low) are assumed to be 5.0 %, 3.5 % and 2.0 %, respectively as the annual growth rate of total GDP at 1994 constant prices during the period 1994 ~ 2015 (Projection I). As a result, the GDP of 2015, using those annual growth rates and the GDP in 1994 of F$ 2,338 million at 1994 prices, is estimated as follows;

Table-4.23 Estimates of GDP at 1994 constant prices in 2015 (Projection I)

Scenario	A (High)	B (Medium)	C (Low)
GDP (Million F$)	6,514	4,815	3,544

Those figures present that the real GDP will increase 2.8 times for High, 2.1 times for Medium and 1.5 times for Low Scenario during 1994 ~ 2015, respectively.

This Result (Projection I) was compared with another projection of GDP (Projection II) which is estimated from GDP per capita and population.

Table-4.22 Population Projections by Watershed Area and by Medium Variant

Watershed	Division	Province	Tikina	1986 Census	Area(km2) in Watershed	Watershed Area(%)in Tikina	Adjusted by Populatyion Density(%)	Population in Watershed Area(1986)	Projection 1996	2001	2006	2011	2015
Rewa	Central	Rewa	Naco	1,796	19	100	100	1,796	1,945	2,054	2,181	2,303	2,387
			Suva	19,630	52	31	0	0	0	0	0	0	0
			Rewa	5,089	31	64	96	4,885	5,291	5,588	5,932	6,265	6,494
			Sub-total	26,515				6,681	7,236	7,642	8,112	8,568	8,881
		Tailevu	Nakelo	7,661	59	100	100	7,661	8,296	8,763	9,301	9,824	10,183
			Bau	20,631	70	71	96	19,806	21,448	22,654	24,047	25,399	26,325
			Verata	7,766	86	25	10	777	841	888	943	996	1,032
			Wainibuka	3,018	192	97	100	3,018	3,268	3,452	3,664	3,870	4,011
			Sawakasa	5,173	9	3	0	0	0	0	0	0	0
			Sub-total	44,249				31,261	33,854	35,758	37,955	40,089	41,552
		Namosi	Namosi	772	120	79	100	772	836	883	937	990	1,026
			Veivatuloa	2,353	10	7	0	0	0	0	0	0	0
			Sub-total	3,125				772	836	883	937	990	1,026
		Naitasiri	Naitasiri	85,534	208	83	50	42,767	46,314	48,918	51,925	54,844	56,845
			Waimaro	3,404	493	100	100	3,404	3,686	3,894	4,133	4,365	4,525
			Lomaivuna	5,092	143	100	100	5,092	5,514	5,824	6,182	6,530	6,768
			Matailobau	3,333	331	100	100	3,333	3,609	3,812	4,047	4,274	4,430
			Wainimala	2,864	443	100	100	2,864	3,102	3,276	3,477	3,673	3,807
			Sub-total	100,227				57,460	62,226	65,724	69,764	73,686	76,375
	Western	Nadroga	Navosa	4,971	39	5	0	0	0	0	0	0	0
		Ba	Tavua	25,509	2	0	0	0	0	0	0	0	0
		Ra	Rakiraki	15,325	63	18	0	0	0	0	0	0	0
			Saivau	7,109	273	70	50	3,555	3,849	4,066	4,316	4,558	4,725
			Nalawa	4,270	244	100	95	4,057	4,393	4,640	4,925	5,202	5,392
			Nakorotubu	4,581	205	56	50	2,291	2,480	2,620	2,781	2,937	3,044
			Sub-total	61,765				9,902	10,723	11,326	12,022	12,698	13,161
Rewa Total				235,881	3,092			106,076	114,875	121,333	128,790	136,031	140,995
Sigatoka	Western	Nadoroga	Sigatoga	11,237	105	50	100	11,237	12,169	12,853	13,643	14,410	14,936
			Baravi	7,293	31	7	1	73	79	83	89	94	97
			Ruailevu	5,041	402	100	100	5,041	5,459	5,766	6,120	6,465	6,700
			Navosa	4,971	612	76	99	4,921	5,329	5,629	5,975	6,311	6,541
			Sub-total	28,542				21,272	23,037	24,332	25,827	27,279	28,275
		Ba	Nawaka	9,742	76	15	4	390	422	446	473	500	518
			Magodro	6,106	121	25	19	1,160	1,256	1,327	1,409	1,488	1,542
			Tavua	25,509	101	16	4	1,020	1,105	1,167	1,239	1,308	1,356
			Sub-total	41,357				2,570	2,783	2,940	3,121	3,296	3,416
	Central	Naitasiri	Wainimala	2,864	5	1	0	0	0	0	0	0	0
Sigatoka Total				72,763	1,453			23,842	25,820	27,272	28,948	30,575	31,691
Nadi	Western	Ba	Nadi	34,215	93	64	80	27,372	29,642	31,309	33,233	35,102	36,382
			Nawaka	9,742	387	78	99	9,645	10,445	11,032	11,710	12,368	12,819
			Magodro	6,106	17			0	0	0	0	0	0
			Sub-total	50,063				37,017	40,087	42,341	44,943	47,470	49,202
		Nadroga	Navosa	4,971	19	3	1	50	54	57	60	64	65
Nadi Total				55,034	516			37,066	40,141	42,397	45,003	47,533	49,268
Ba	Western	Ba	Ba	44,416	285	81	85	37,754	40,885	43,184	45,838	48,415	50,181
			Magodro	6,106	320	65	85	5,190	5,621	5,937	6,301	6,656	6,899
			Tavua	25,509	271	41	1	255	276	292	310	327	339
			Sub-total	76,031					46,782	49,412	52,449	55,398	57,419
		Nadroga	Navosa	4,971	61	8	1	50	54	57	60	64	66
Ba Total				81,002	937			43,249	45,836	49,469	52,509	55,461	57,485
Grand Total				444,680	5,998			210,233	227,671	240,471	255,250	269,601	279,438

According to the past statistics, the real growth rate of GDP per capita for the period of 1990 ~ 1994 indicated 1.2 % on average ranging from -1.1 % to 2.6 %, as shown in the Table-4.6. Judging from those growth rates, the future trend of the annual growth rates for the period 1994 ~ 2015, are assumed to be 4.0 % for the Scenario A (High), 2.5 % for Scenario B (Medium) and 1.0 % for Scenario C (Low).

Using those annual growth rates and per capita GDP of F$ 3,002 in 1994, the per capita GDP at 1994 constant prices in 2015 is estimated as follows.

Table-4.24 Estimates of GDP per Capita at 1994 constant prices in 2015 (Projection II)

Scenario	A (High)	B (Medium)	C (Low)
Per Capita GDP (F$)	6,841	5,042	3,700

According to the population projection made above, the 2015 population of Fiji is estimated at 935,789 (by medium variant). The estimates of the population and the GDP per capita at 1994 constant prices would give another projection of the GDP in 2015, as shown below:

Table-4.25 Estimates of GDP at 1994 Constant Prices in 2015 (Projection II)

Scenario	A (High)	B (Medium)	C (Low)
GDP (F$ Million)	6,402	4,718	3,462

The GDP (Projection II), which is estimated indirectly, is close to the foregoing direct estimate of GDP (Projection I), though slight somehow low value in general. The comparison of the results of GDP estimated by Projection I and II may show that Projection I by direct estimation might be a reasonable projection.

As for the activities of Primary, Secondary and Tertiary Industry, taking into consideration the past trend (Table-4.7) and the future prospects, that is, the share of the Primary Industry will decrease, and those of the Secondary and Tertiary Industry will increase, the shares of respective industry in 2015 are assumed to be 20 % for Primary, 19 % for Secondary, 64 % for Tertiary Industry and -3 % for Imputed Service Charges. As a result, in Medium Scenario, GDP of Primary Industry shall amount to F$ 963 million, Secondary Industry to F$ 915 million, Tertiary Industry to F$ 3,081 million and Imputed Service Charges to -144 million, respectively in 2015 (refer to Table-4.26).

Table-4.26 Estimate of Gross Domestic Product (GDP) of 2015 at 1994 Constant Prices

(F$ million)

Activities	GDP by Activity		2015 GDP by Activity			
	1994	Share (%)	High	Medium	Low	Share (%)
1. Primary Industry	521	22.3	1,303	963	709	20
2. Secondary Industry	404	17.3	1,238	915	673	19
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	1,494	63.9	4,169	3,081	2,268	64
4. Imuputed Service Charges	-82	-3.5	-196	-144	-106	-3
All activities	2,338	100	6,514	4,815	3,544	100
GDP per Capita (F$)	3,002		6,961	5,145	3,787	
Population (persons)	772,655		935,789	935,789	935,789	

Remarks 1) Real Annual Growth Rates assumed to be 5.0 % for High Rate, 3.5 % for Medium and 2.0 % for Low.
2) Share in Industries in 2015 assumed to be 20 % for Primary, 19 % for Secondary and 64 % for Tertiary Industry and 3 % for Imputed Service Charges .
3) Population projection based on Medium Variant.

Source: Bureau of Statistics, 1996 for GDP in 1994

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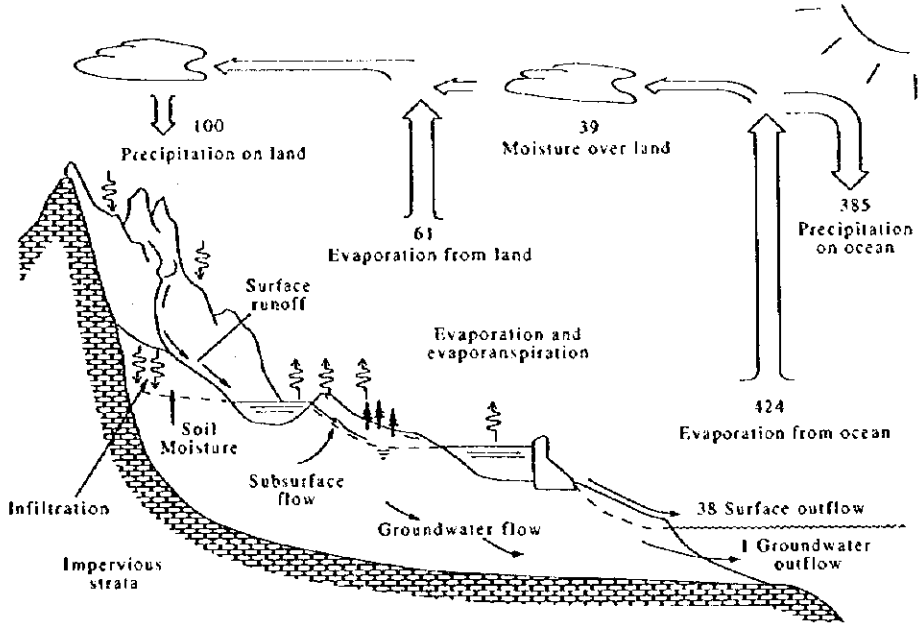
CHAPTER 5 WATERSHED MANAGEMENT

5.1 Concept of Watershed Management

The global hydro-logical cycle is illustrated as shown in Figure-5.1. Generally, the management on each phase in the cycle, from precipitation to the earth to inflow to the sea has been carried out separately. Since the phase changes continuously and interact with each other, the management for each phase could not be independent but interrelated.



Hydrologic cycle with global annual average balance given in units relative to a value of 100 for the rate of precipitation on land.

Figure-5.1 Global Hydro-logic Cycle

In order to draw an ideal portrait of the watershed management, the Study defines the framework of the watershed management formed by two (2) fold of interactive systems; 1) hydrological cycle - river basin system, and 2) human activity - ecology system related to water. The former system is an integrated surface and sub-surface water system with basic dimensions of quantity, quality, time and space. The later is an interactive biosphere between human activity and ecosystem relating to water.

The Study also defines a "Watershed Management" as management of water resources consisting of surface and sub-surface water, flood, environmental conservation and improvement of ecosystem, soil erosion, and water quality as illustrated in Figure-5.2.

Flood Control management and water use management are major components aiming to achieve people's social well being in the sphere of watershed management. The water use management consists of surface and sub-surface water supply and use, and hydropower generation. Environmental conservation and improvement management aims at symbiosis of human activities and natural environment such as waste water treatment, soil erosion control, and afforestation. The fringes of these management have a strong tendency to

expand and interrelate responding to development of region's economic as indicated in Figure-5.2.

Therefore, integrated view of watershed management will be necessary for preservation and/or restoration of natural and social environment. However, it will take a long term to accumulate enough data and information which are required to establish the complete watershed management plan and it can be said that in Fiji accumulation of such data and information has just started. In the following sections, the Study Team discusses the various watershed management issues as much as possible despite of limited data and study period. As mentioned in Chapter 1, Introduction, the flood control is the main objective in Fiji among other watershed management issues, and this matter is discussed in detail in Chapter 6.

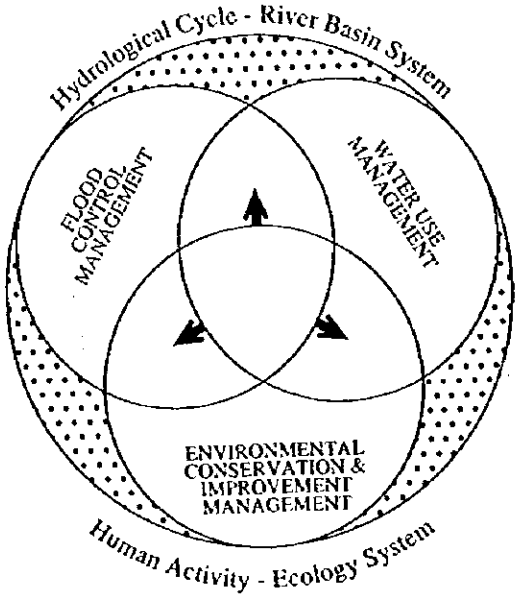


Figure-5.2 Framework of Watershed Management

5.2 Land Use and Regional Development

5.2.1 Present Land Use

(1) Land Use in Viti Levu Island and Study Area

Among 5,998 km^2 of the total Study Area, about 59 % of the island is covered with forests (both natural and plantation) and one third is agricultural land. About 2 % is cities and towns or urban area. The rest is under-utilized land including grassland.

The land use shows clear contrast between the east and the west due to the climatic difference. Sugarcane is dominant in the flat land of the dry western area. In the wet eastern area, forest is still rich and agricultural crops are characterized with rice and vegetables. Grazing is undertaken in the undulating lowland and hills in both eastern and western areas.

Due to the finely undulating configuration, clear macroscopic agricultural zoning is difficult except sugarcane zone and rice zone. In a microscopic view, each land use is scattered in patches and mixed like mosaic. Forest zone and Agriculture/Grazing zone were identified based on the Forest Function Map by the Department of Forest and the topographic maps of the Department of Lands and Survey.

Table-5.1 Land Use in Viti Levu and Watershed

(Unit : km^2)

Land Use	Rewa		Sigatoka		Nadi		Ba		Total of Water-shed	Viti Levu Total
Forest *1	2,164	70 %	719	49 %	248	48 %	399	42 %	3,530	6,135
Agriculture *2	160	5 %	139	10 %	132	26 %	233	25 %	664	1,330
Sugarcane	12	0 %	29	2 %	92	18 %	186	20 %	319	862
Other crops	148	5 %	110	8 %	40	8 %	47	5 %	345	468
Grazing	399	13 %	423	29 %	93	18 %	165	18 %	1,080	1,878
Grassland & Others	349	11 %	169	12 %	22	4 %	130	14 %	670	827
Urban *3	20	1 %	3	0 %	21	4 %	10	1 %	54	218
Total	3,092	100 %	1,453	100 %	516	100 %	937	100 %	5,998	10,388

*1 Department of Forest (1996), Unpublished data
*2 Estimated from the data of MAFF, 1991
*3 Municipality and Peri-urban area : JICA Study Team estimation
(JICA Study Team estimation based on MAFFA data)

The present land use is shown in Figure-5.3 and the pictorial characteristics of the 4 watersheds are shown in Figure-5.4.

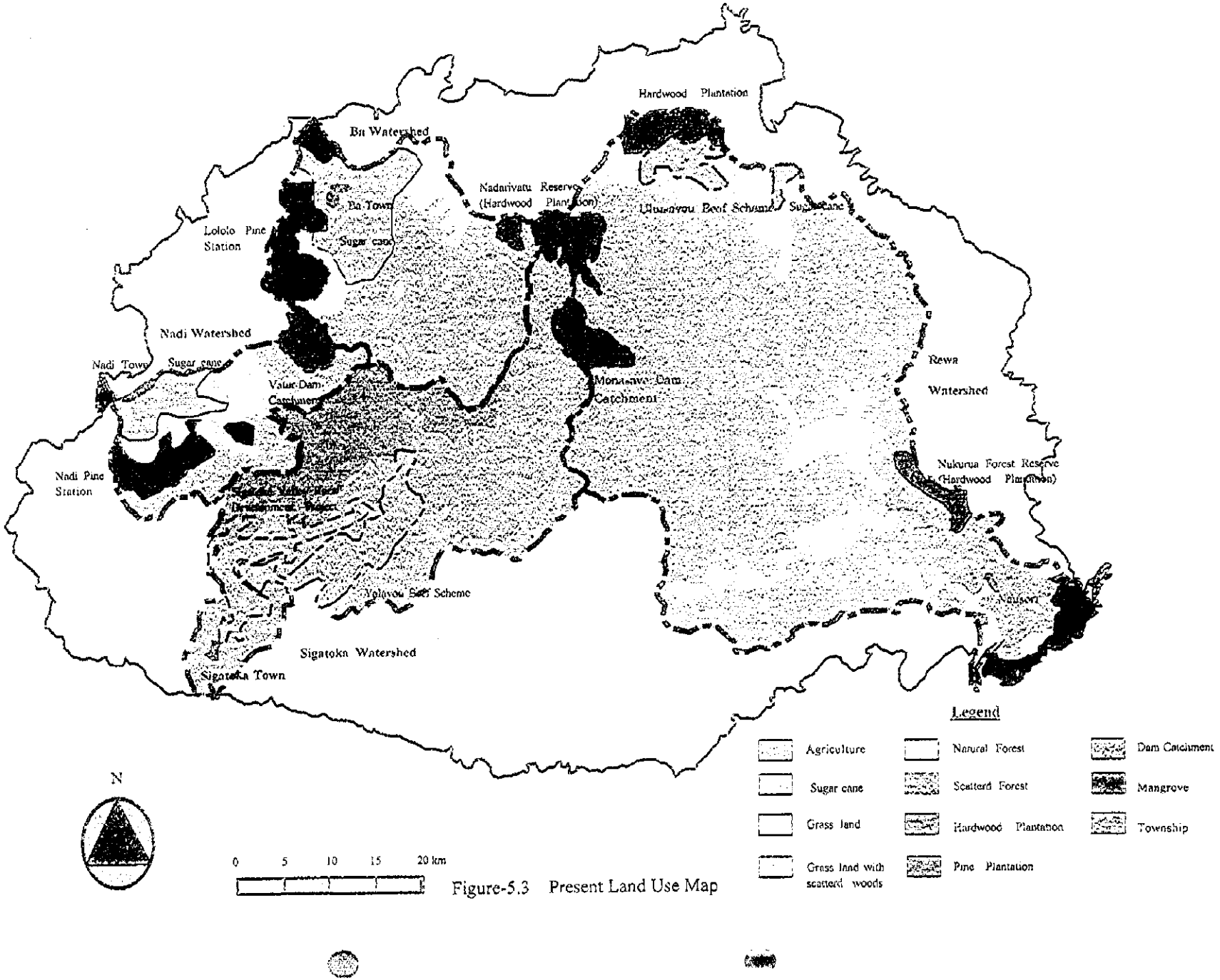


Figure-5.3 Present Land Use Map

Ba Watershed

2) **Sugar cane and pine plantation**
Almost whole lower reach is sugar cane. Lololo pine plantation extends. The short-range view of the picture is sugar cane and the distant view is pine plantation.

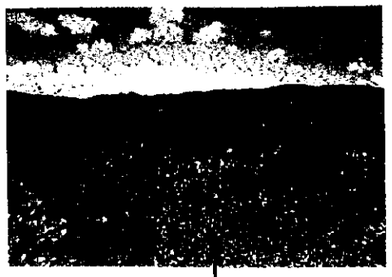
1) **Scattered forest / grassland and agriculture**
Grassland with scattered forest extend in the middle reach. Flat patches are cultivated from place to place.

Nadi Watershed

3) **Sugar cane in the lower reach**
Almost whole lower reach is occupied with sugar cane cultivation, extending the marginal area.
The same land use is observed in the lower reach of Ba watershed.

4) **Marginal cultivation**
The lower grassland is partly cultivated on slopes with thinly scattered woods.

1) **Natural forest in Monasavu dam catchment**
The catchment of Monasavu dam is a typical natural forest and it is being designated as a protection area. However a part has been logged out.



Rewa Watershed

2) **Forest in the middle reach**
Most of the middle reach is mountainous and covered with forest. Some points are completely logged out even on steep slops.

3) **Grazing in the middle reach along the river**
There are flat areas located along the river suitable for agriculture and grazing.

6) **Erosion on slope cultivation**
Exploitative slope cultivation causes severe soil erosion which gives great damages both to that land and the downstream.

5) **Agricultural experiment mitigating erosion**
Hedge-raw planting and terracing will mitigate soil erosion on the slop cultivation. Although this landscape and practice is not popular at present, it should be extended together with agroforestry.

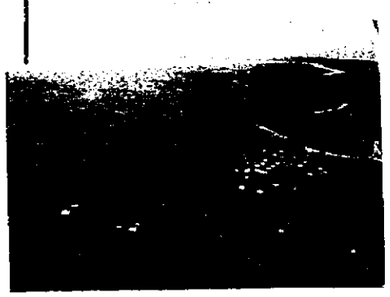
Sigatoka Watershed

2) **Grassland in the middle reach**
There extend grassland of little use in the middle reach. Forest is scattered along the valleys. Burning is practiced unnecessarily.

1) **Vatur dam and natural forest**
Natural forest is located in the west upper reach.

1) **Scattered forest and farms in the middle reach**
Agricultural areas are located along the river. The rest is undulating and the forest in the mountains are not dense or no forest.

2) **Grazing in the middle reach**
Vegetation is comparatively poor in particular in the hilly areas and soil erosion proceeding.



4) **Agriculture and settlement in the delta**
Agricultural area extends in the wide delta with scattered forest

Figure-5.4 Characteristics of Present Land Use

(2) Land Use in Watershed

1) Rewa Watershed

About 70 % of the watershed is covered with forests, which consist of protection forest and multiple-use forest etc. The delta is mixed use of agriculture, township, grazing, forest and grassland. Mangrove is clustered along the coast. The agriculture is characterized by rice cultivation with irrigation. Vegetables and crops are farmed in the land along the river and the road to Vunidawa in the middle reach. There is sugarcane cultivation along the King's road in the most upper stream and Uluisaivou Beef Scheme in mildly undulating land on the foot of Nakauvadra Range and along Wainibuka river.

Present land use of the flood prone area is as follows:

Most of area is agricultural land dominated with rice; however, rice cultivation has declined recently and vegetable cropping, grazing and housing have expanded. The Nausori Irrigation Project stopped operation in 1995. Nausori town is expanding and urbanization of the area along the road connecting with Suva is proceeding. There are various facilities including market, shops, offices, schools, airport, industrial estate and housing. East and south coast is surrounded by mangrove.

2) Sigatoka Watershed

In the most upper stream, there is hardwood plantation and forest remains only the upper stream boarders. Low utilized grassland extends in the middle reach. There is Sigatoka Valley Rural Development Project along the river, producing various vegetables, crops and fruits with irrigation facilities. Large Yalavou Beef Scheme is on the east side of the river. Potential land suitable for grazing and planting is distributed in the middle reach.

Present land use of the flood prone area is as follows:

The commercial center of Sigatoka town is the market on the west bank of Sigatoka river. Residential area is extended to the north and the west, and on the east bank. Institutional facilities such as public offices and schools are distributed in the south. Fijian villages are located both side of the river.

3) Nadi Watershed

Forests exist in the east upper stream border and Nadi pine plantation is in the south. Almost whole flat lower reach is sugarcane cultivation. Cultivation is slowly expanding to the marginal area to the undulating grassland which extends in the middle reach. Grassland is low utilized and burned from time to time unnecessarily.

Present land use of the flood prone area is as follows:

The major part of Nadi town where the commercial center is located is in the flood prone area. Sugarcane field and Fijian villages of Saunaka, Nawaka Narewa, Sikituru and Vunayasi are liable for flooding.

4) Ba Watershed

Forests are distributed on the south divide and part of east divide. Lololo pine plantation is in the west. Most of the flat land is sugarcane cultivation. Grassland extends in the middle reach with scattered small agriculture, grazing and plantation.

Present land use of the flood prone area is as follows:

The commercial center and Rarawai Mill is located on the east bank of Ba river. The public/civic areas are both on the east and west bank and the residential areas are surrounding the center of Ba town and expanding to all directions. Sugarcane fields along the lower reach are liable for flooding.

(3) Agriculture

1) Agricultural Land

Area of the agricultural land was 5,914 km^2 (32 %) in Fiji in 1991, and the agricultural land in the Central and Western Division (nearly equal to Viti Levu) was 3,465 km^2 (33 %). It has been increasing remarkably (Table-5.2), and it is apparent that almost all arable land in a good condition has been utilized.

Table-5.2 Expansion of Agricultural Land Use

Census Year	Cultivation		Pasture		Others		Total
	km^2	%	km^2	%	km^2	%	km^2
1968	1,450	60 %	370	15 %	600	25 %	2,420
1978	1,170	37 %	-	-	2,030	63 %	3,200
1991	2,238	38 %	2,009	34 %	1,667	28 %	5,914

Source : MAFFA, 1996

Among the areas for agricultural purpose in the Central and Western Division, sugarcane was dominant amounting to about 80,000 ha or 63 % in 1995. Root and tubers such as dalo, yam, yangona, cassaba, ginger etc. occupied 29,000 ha or 23 %, rice/maize 7,000 ha and fruits/vegetables 5,000 ha in 1995 (Table-5.3).

Table-5.3 Cultivation Area by Crops and by Province, 1995

(unit : ha)

Division and Province	Sugarcane	Rice & Maize	Roots & Tubers *1	Fruits & Vegetables	Tree Crops *2	Total (ha)
Central	0	3,834	19,330	1,978	3,007	28,149
	0 %	14 %	69 %	7 %	11 %	100 %
Naitasiri	0	574	8,303	1,273	742	10,892
Namosi	0	3	846	46	5	900
Rewa	0	1,547	600	124	578	2,849
Serua	0	506	7,611	128	6	8,251
Tailevu	0	1,204	1,970	407	1,676	5,257
Western	80,008	3,653	9,524	3,230	2,020	98,435
	81 %	4 %	10 %	3 %	2 %	100 %
Ba	53,097	752	3,248	695	797	58,589
Nandroga	15,366	2,542	4,224	2,421	360	24,913
Ra	11,545	359	2,052	114	863	14,933
Total	80,008	7,487	28,854	5,208	5,027	126,584
	63 %	6 %	23 %	4 %	4 %	100 %

*1: Dalo, Cassava, Yam, Yaqona, Kawai, Ginger etc.
*2: Citrus fruits, Banana, Coconuts, Cocoa etc.
Source: MAFFA, 1996

2) Livestock

The number of livestock has been steadily increasing (Table-5.4), however only the beef production decreased. Recently, the local competitiveness is getting hard to the imports in terms of price and quality. To cope with this issue and develop of the livestock industry, the following improvement shall be made.

- To improve pastures for fattening and breeding cattle as well as for prevention of soil erosion
- To upgrade infrastructure and facilities such as access roads, slaughterhouse and cold storage
- To improve marketing system

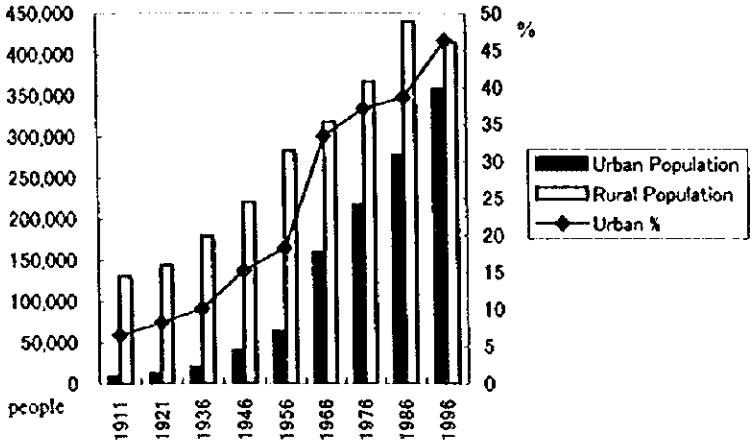
Table-5.4 Livestock Farming

	1990	1991	1992	1993	1994
Beef Cattle (heads)	53,798	55,634	57,470	59,366	62,928
Dairy Cattle (heads)	37,099	36,805	37,396	37,396	37,695
Pig (heads)	95,000	99,000	105,000	110,000	115,000
Goat	179,371	187,235	195,099	203,293	211,831
Sheep		413	637	854	1,595
Broiler (Number of Farms)	23	24	24	24	24

Source: MAFFA, 1995

(4) Urban Land Use

Urbanization, urban population and concentration to urban area is steadily increasing. The change during 1986 to 1996 was drastic. More than 25 thousand rural population converted to urban population and the rate of urban population was counted 46 % in 1996.



Source: Bakker and Walsh (1976) and the provisional results of 1996 census

Figure-5.5 Growth of Urban Population

Population density in the urban area was as low as 8 people per ha in average of Nausori, Sigatoka, Nadi and Ba as shown in Table-5.5. The urban area will be expanded according to the increase of urban population.

Table-5.5 Population of Urban Area in Viti Levu Island, as of 1986

Urban Area		Nausori	Sigatoka	Nadi	Ba	Sub-total	Suva	Lami	Lautoka	Other Towns	Total
Municipality	**Municipality**										
	Population	5,242	2,097	7,709	6,515	21,563	69,665	8,597	28,728	0	128,553
	Area (ha)	330	80	520	340	1,270	2,300	630	1,020	0	5,220
	Density (people/ha)	16	26	15	19	17	30	14	28	0	25
Peri-urban or non municipal Township	**Peri-urban or non-municipal Township**										
	Population	8,740	2,633	7,511	3,745	22,629	71,608	8,110	10,329	13,492	126,168
	Area (ha)	1,620	230	1,540	650	4,040	6,500	2,070	1,260	2,690	16,560
	Density (people/ha)	5	11	5	6	6	11	4	8	5	8
Urban Total	**Total**										
	Population	13,982	4,730	15,220	10,260	44,192	141,273	16,707	39,057	13,492	254,721
	Area (ha)	1,950	310	2,060	990	5,310	8,800	2,700	2,280	2,690	21,780
	Density (people/ha)	7	15	7	10	8	16	6	17	5	12

(Note: Peri-urban areas are administrated by rural local government.)
Source Bureau of Statistics, 1996

(5) Land Use Conditions

Present conditions of land use are summarized in Table-5.6 and present major infrastructure is shown in Figure-5.6.

Table-5.6 (1/2) Summary of Land Use Conditions

	Rewa	Sigatoka	Nadi	Ba
Topography and Climate	•A wide delta area is formed at the mouth of the river. •The configuration is generally undulating. •Rairainatuku plateau which include the highest mountain in the west, bounds on Sigatoka watershed. •The watershed is in the wet zone which has much rain and the annual rainfall in the mountainous area reaches 4,000 mm.	•The area along the river in the middle reach is alluvial flat land. The other area has steep topography. •The area is in the dry zone. •Rairainatuku plateau is in the east and Nausori highland is in the north-west.	•The configuration is generally undulating. The lower reach forms the alluvial plain. •Nausori highland is in the west. •The area is in the dry zone.	•The configuration is generally undulating. The lower reach forms the alluvial plain. •Mount Evans Range is in the south-west and Naloto Range is in the south-east. •The area is in the dry zone.
Forest	•Forest cover is as high as 2,164 km^2 or 70 %, and dense to medium dense forests dominate. •Partly Nukurua hardwood plantation is included. •Mangrove forest is formed in the coastal area of the delta. •Some parts in the catchment of Monasavu dam has been logged out.	•Forest cover is 719 km^2 or 49 % and scattered to medium dense forests dominate. •Hardwood plantation is in the upper stream. •Grassland with scattered small woods expands in the middle reach.	•Forest cover is 248 km^2 or 48 % and scattered to medium dense forest and pine plantation dominate. •Grassland with scattered small woods in the valleys expands in the middle reach. •Mangrove forest is formed in the coastal area of the delta. •Nadi pine plantation expands in the south.	•Forest cover is 399 km^2 or 43 % and scattered to medium dense forest and pine plantation dominate. •Grassland with scattered small woods expands in the middle reach. •Mangrove forest is formed in the coastal area of the delta. •Lololo pine plantation expands in the west.
Soil Erodibility (by Department of Forests)	•The soil erodibility in the watershed is generally "high". The erodibility of the grassland and the beef scheme area along Wainbuka river in the upper reach, is "severe". •The erodibility of the delta is "low" to "moderate".	•The erodibility in almost all watershed area is "severe" except the low land along the river and the part of Nausori highland.	•The erodibility of most watershed area is "severe", except the plain and part of forest area.	•The erodibility of most watershed area is "severe", except the plain and part of forest area.
Soil Movement	•Sedimentation at the mouth of the river is high and dredging is carried out. •Landslides occur by cyclones and heavy rain and by human activities. •Soil erosion by ginger cultivation is severe, even though area is small compared to the watershed area.	•It is anticipated that the soil erosion in the vast grassland, grazing and the logged out areas around Bukuya etc. is high.	•It is anticipated that the soil erosion in the grassland and the sugarcane in marginal area is high.	•It is anticipated that the soil erosion in the grassland, grazing and the sugarcane in marginal area is high. •Sedimentation at the mouth of the river is high and dredging is carried out.
Agriculture	•The cultivation area extends in the delta. Rice farming with irrigation dominates. There are wide potential agriculture areas remained in the delta. •There are small crop areas and grazing along the river up to the middle reach. Potential agriculture land partly remains to be developed. •Uluisaivou Beef Scheme is in the northern upper reach	•Various crops such as vegetables and fruits etc. are cultivated in the Sigatoka Valley Development Project along the river. •Sugarcane is farmed in the east of the lower reach. •Yalavou Beef Scheme is in the east of the river of the middle reach. •Unplanned burning practice in the grassland will deteriorate the land.	•Sugarcane is cultivated all over the plain in the lower reach. •Unplanned burning practice in the grassland will deteriorate the land.	•Sugarcane is cultivated all over the plain in the lower reach. •Unplanned burning practice in the grassland will deteriorate the land.

Table-5.6 (2/2) Summary of Land Use Conditions

	Rewa	Sigatoka	Nadi	Ba
Urban Use	•A commercial area is developed in Nausori town with the market, offices and schools etc. •Industrial estate with a rice mill is along the King's Road. •In addition to the residential areas within the town boundary, residential development within the peri-urban area, are located east, west and south of the town.	•A commercial area is developed in Sigatoka town with the market, offices, schools etc. •Built-up residential areas are located south of the town. Development is progressing in Kulukulu - Veivadravadra areas toward the river mouth.	•A commercial area and tourism facilities are developed in Nadi town with the market, offices and schools etc. •Hotels and restaurants are developed along the Queen's Road. •Extension of the residential areas include Malolo in the south and Vatualevu in the east. Major hotel development is located in Denarau, south west of the town.	•A commercial area is developed in Ba town with the market, offices and schools etc. •Rarawai mill and its related facilities of FSC are at the town. •Residential development have extended south and west of the town in Koronubu and Yalalevu - Namousau area.
Infrastructure	•Monasavu dam supplies electricity for most demand of Viti Levu island. •The King's road runs in the lower reach and the east of the upper reach. There is a road to Tavua via Monasavu dam in the center of the watershed. •Nausori International Airport is located in the south.	•The road along the river runs to Korolevu of the middle reach and also is connected with Nadi and Ba via Bukuya.	•Vaturu dam supplies water to Nadi and Lautoka. •The Queen's Road runs north - south and the road to Bukuya runs east - west. •Small roads and tram ways are developed in the plain. •Nadi International Airport is located in the north adjacent to the municipality boundary.	•The King's road runs east - west and the road to Bukuya runs north - south. •Small roads and tram ways are developed in the plain.
Land Tenure	•The native land covers most of the watershed. The native reserve extends in the upper reach.	The native land covers most of the watershed. The native reserve extends about half of the middle and upper reach. The leased native land exists in the lower reach.	•The native land covers most of the watershed. The native reserve extends in the upper reach. The leased native land exists in the plain. There are free hold lands in and around Nadi town.	•The native land covers most of the watershed. The native reserve extends in the plain. There are free hold lands in and around Ba town.

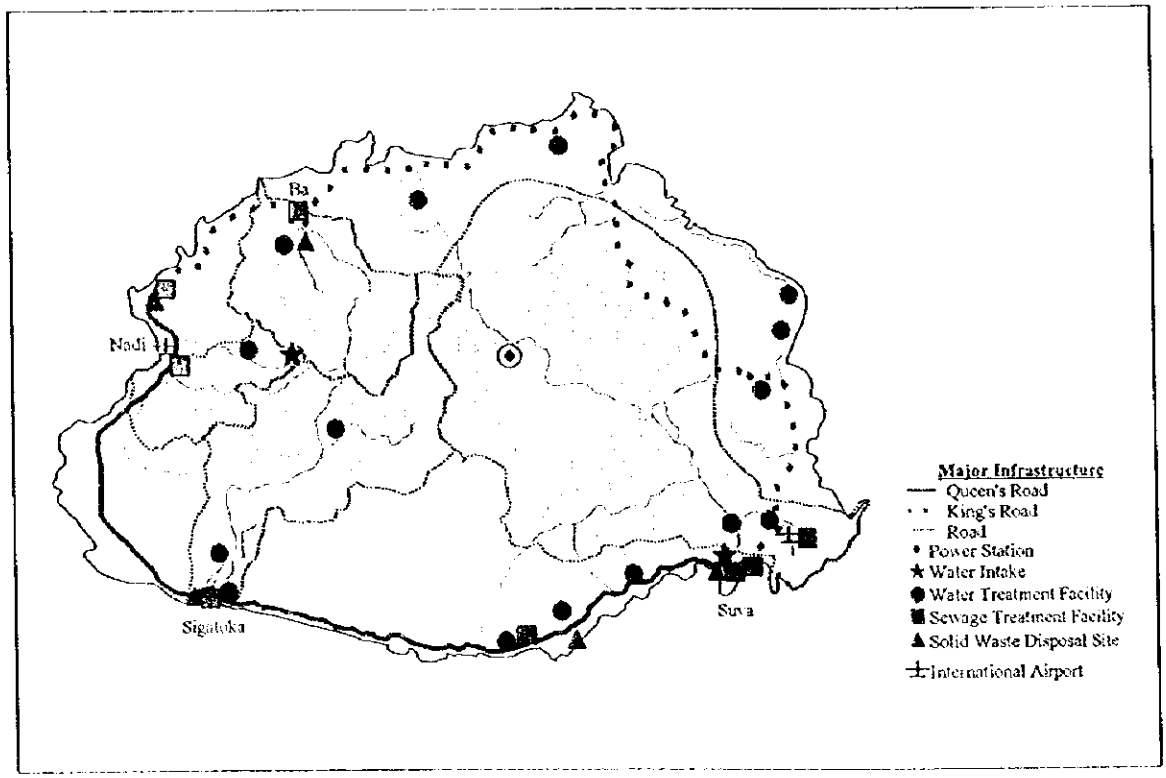


Figure-5.6 Major Infrastructure

5.2.2 Future Land Use

(1) Strategic Policy of Regional Development

1) Land Use Potential

- The central mountainous area has potential for forest because of heavy rainfall.
- The grassland in the western area should be developed with plantation and grazing taking into consideration of mitigation of soil erosion and runoff control.
- Potential arable land is located in the Rewa delta and the flat land along Rewa river.
- More intensive use of agricultural land is expected because of the present utilization.
- To improve the productivity of agriculture, irrigation and other measures should be introduced as required.
- Tourism development around Nadi seems promising.

2) Policy from the basic conditions

The following five policies are led from the basic conditions described in the above.

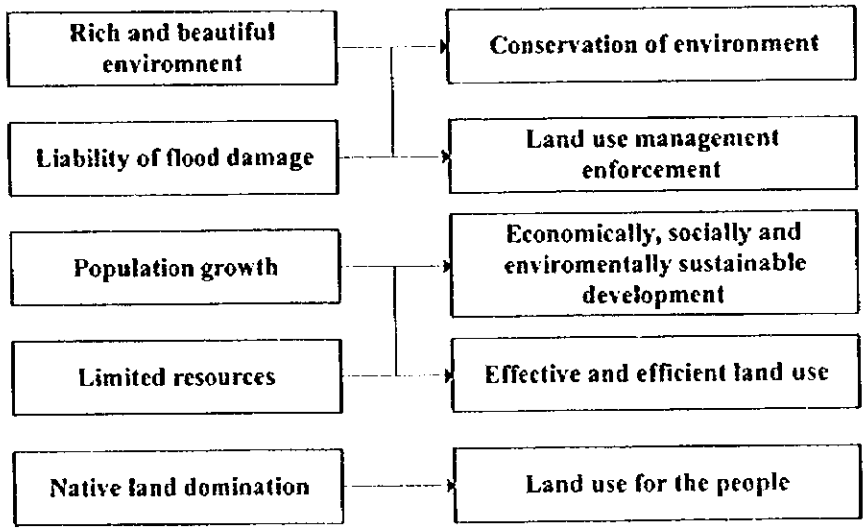


Figure-5.7 Policy of Land Use

a) Conservation of Environment

Conservation of environment should be considered on the basis of people's happiness and life. People in Fiji have been fostered by the rich and blessed environment. The nature has recovered from little human exploitation or influence. However, the nature and the land is vulnerable, and once the environment has got damages, the recovery would take time and be costly. In order to avoid degradation of environment, activities harmful to the nature seeking only for short-term mercenary benefit should be regulated. Sound natural water cycle (rain - flow - evaporation - rain) should be formed with proper land use.

The forest in the western zone vanished long time ago. Precious natural forests including mangrove should be conserved and maintained. The logged out forest may remain as "forest" with proper logging practice, carefully considering the configuration and planting density etc.

b) Land Use Management Enforcement

There are two aspects in the effect of land use on watershed. One is land use inducing more runoff and another is land use causing soil erosion and pollution of water and so on.

The main measure for the former is land use control including preservation such as nature reserve, forest reserve and national park etc. In urban area, severe flood prone area may not be utilized for building but for parks or green zone etc.

The main measure for the latter is appropriate cultivation practice especially on slope land, proper logging practice, fire prevention and adequate waste water treatment etc. This would be promoted with education, public relation and enlightenment etc. through schools, the governmental offices, the disaster management network and local administration structure etc. In addition to logging practice, soil erosion from farms on slopes should be mitigated by appropriate farming practice such as terracing and contour planting. Civil works should be carefully carried out e.g. site preparation and road construction etc. and be controlled and enforced.

The existing land use data (Land Use Section, 1979) needs to be revised because the land use has been changed since 1979 with developments. The land use study proposed should be implemented to formulate the proper land use plans.

"Sustainable Development Act" will soon be proclaimed and legal base will be prepared. A comprehensive land use plan will also be prepared in relation to the Sustainable Development Act. The land lessor and the managing organization should patrol the land and take care of good husbandry practice by legal basis.

c) Effective and Efficient Land Use

As the land and water resources are limited and scarce, the land shall be utilized effectively and efficiently.

The flat and accessible arable land has been already utilized. In order to increase productivity of agriculture with limited land, intensive agricultural practice should be carried out rather than extension and development of new farms.

Grassland is a significant issue. It should be utilized as grazing, planting, subsistence or recreational park in order to prevent soil erosion and mitigate runoff.

Locating buildings and facilities which are liable to have costly losses by inundation should be refrained from the flood prone areas. Severe flood prone area may be used as grazing.

d) Economically, Socially and Environmentally Sustainable Development

To sustain the increasing people, the land should maintained and developed in a continuously sustainable manner for the future.

e) Land Use for the People

Land is for the people. Therefore, mutual consent of people concerned, is necessary for any land use development.

(2) Future Land Use Projection

1) Land Use Direction

Future land use will not be set from the historical trend but watershed and land use policy. As described in the section 5.5, Forest and Soil Erosion, afforestation should be implemented and the existing grassland and wasteland should be converted to forest in principle. In the forests, subsistence farming would be conducted to supplement agricultural activities.

Land use change in future is basically as follows:

- Expansion and conservation of forests (conservation of existing forest, afforestation of grassland/wasteland and reforestation of grazing with high erodibility and logged out area)
- Increase of agricultural land (crop land and grazing) with small conversion of existing agricultural land to forest or sustainable pasture
- Increase of urban and built-up area (small percentage to the total area but large influence to socio-economy)
- No room for further crop land expansion in the Nadi and Ba watersheds

2) Development Scheme

a) Forest Conservation and Afforestation

Forests retain rainfall and reduce liability of soil erosion. They also maintain eco-system and create scenic and landscape beauty. They provide subsistence base. Once they are lost, recovery takes time and difficulty. Therefore, the existing forests should be conserved as much as possible. The forest that sustain the traditional life is to be passed to the future generations.

Significant forests in terms of nature, ecology or water resource management including Monasavu dam catchment area and Nausori highland forest, are already reserved, but there are important forests left not designated as protection area such as Vaturu dam catchment area etc.

Afforestation with various species in addition to sole pine or mahogany should also be promoted to create eco-system and improve runoff condition.

Eco-tourism and cultural tourism should be promoted in the central area of the island with research facilities of ecology, forestry and culture. Eco-tourism may not earn

much money but it will add variety and attraction of tourism resources and promote tourism, while conducting researches.

b) Agricultural Development

Sugarcane will be stayed as dominant crop, but its area has been already extended to the limit. On the other hand, there is a problem of international competitiveness in price. Therefore, the area of sugarcane will remain the present range or some part near towns may be converted to vegetables and commercial cropping.

Agricultural area will increase in the Rewa and Sigatoka watersheds, while the expansion will be difficult in the Nadi and Ba watersheds. As there is little room for accessible and sustainable crop land, improvement in cultivation practice and productivity shall be promoted as follows:

- proper and intense cultivation increasing yield and cropping rotation
- promotion of proper cultivation practice on slope lands such as hedgerow planting and agroforestry
- breed improvement and its extension
- good husbandry matching to the land characteristics and marketing

The Beef Schemes in the upper reach of Rewa river and in lower and middle reach of Sigatoka river will be expanded. Therefore, improvement of the pastures is the most important. Afforestation and reforestation in the land with high erodibility, especially pastures on slopes shall be densely vegetated with hedgerow planting for prevention of erosion. As the pastures can be formed faster than forest, it should be promoted with financial and technical assistance of the government. Expansion of grazing area in the 4 watersheds is estimated as some 828 km^2 with small increase of the number of cattle (Table-5.7).

Table-5.7 Future Grazing Land

	heads	ha/heads	ha
Beef Cattle	33,000	0.8	26,400
Dairy Cattle	34,000	0.8	27,200
Goat	140,000	0.2	28,000
Sheep	3,000	0.4	1,200
Total Area	-	-	82,800

c) Urban Development

Urban areas absorb much population and industries in spite of small area compared to the whole watershed. Expansion of residential areas for increased population is one of major urban development.

Tourism will play the most important role. In the vicinity of the Nadi watershed, there are large scale tourism development projects in Vulani island and along the Nadi Bay coast as well as Denarau. Taking advantage of good access to the international airport and the resorts, preparation of a cultural core by a international conference hall with multi-purpose functions will contribute to promote tourism in Nadi. Network of

international research organizations will create needs of such facility as Fiji is the hub of the South Pacific.

Future urban development expected in the 4 watersheds is summarized in Table-5.8.

Table-5.8 Future Urban Land Use

Town	Nausori	Sigatoka	Nadi	Ba
Residential	In addition to present town boundary, residential development is expanding along the major roads in the surrounding rural area.	Residential development is in the south and west of the town. Also there are residential development along the Queens road on the east bank.	The new residential core in the north and the south will be developed as well as the expansion along the Queens road.	The residential development is expanding all directions in particular to the south and west.
Commercial	The existing commercial center and the area along the Kings road will expand.	The existing commercial center will be expanded.	The existing commercial centers are expanding.	The existing commercial center will be developed further.
Public/Civic	The public/civic area in the east of the center will be developed. Also there will be development on the west bank.	The southern and western public/civic area will be developed.	Large part is located in the town center and will be expanded and upgraded.	The public/civic areas are located in both east and west bank.
Park	The river bank areas in the south of the bridge should be developed as parks. The historical remain forts should be developed for parks.	The area south of the town will be developed for park.	A public park and recreational area will be required.	There will be parks in both east and west bank.
Industrial	Industrial development will be along the east bank, which is liable to inundation.	The industrial development will be south of the town and the east bank.	A small industrial development will be in the south of the airport.	The major industrial development will be the existing Rarawai Mill and its east area.
Others	The existing disposal site of solid waste shall be replaced to new site.	Expansion of the bus terminal and parking will be issues in the limited area.	Tourism development is expected along the Queens Road. Denarau Island is still developing.	The new bridge area outside the town boundary is expected to be developed.

The commercial zone and industrial zone shall not be located in the flood prone area in principle. As the suitable area for commercial and industrial zone is limited, the flood control measures will facilitate the commercial and industrial development and expansion. Thus the urban development depends on implementation of flood control measures. Necessity of flood control measures is discussed below.

- Nausori

Nausori town is located strategic location between the international airport and Suva, which is cultural, political and commercial center of Fiji. Nausori is developing as a part of the Greater Suva Metropolitan Area or as a bed town of Suva. There are wide flat land around Nausori which gives opportunity for industrial and residential development, whereas flat lands are limited in Suva. The flood control measure would facilitate the commercial, residential and industrial expansion of the area.

- Sigatoka

Sigatoka town and villages are developing along the river. If the flood control measure was taken, Sigatoka town would be a center of agro-industry and marketing of crops produced in Sigatoka Valley to distribute to Suva and Nadi.

- Nadi

The existing central commercial zone (Nadi town) is the only place of shopping and dining for tourists and visitors. However, it is the most flood prone area. With flood control measure, development of the area would be accelerated.

- Ba

The town will expand around the existing commercial zone. The flood protection measure will provide possibility of development for a industry in addition to the existing sugar mill.

d) Town Planning Scheme

There are town and rural schemes in and around the major cities and towns, designating land use based on the town and country planning guideline, in accordance with the Town Planning Act (and Order, Regulation).

The guideline for the Town Planning Scheme sets zoning and the respective regulation for specific land use, such as minimum site area, minimum street frontage, minimum side and rear clearance and plot ratio. The zoning consists of "Residential A to D", "Commercial A to C", "General, Heavy and Noxious Industry", "Civic", "Rural", "Noise hazard" and "Special use". The minimum site area is 200 m^2 for "Commercial A and B" and 1,000 m^2 for "Residential A".

Minimum floor level of habitable room in flood prone area is stipulated in Town Planning Act - General Provisions. However, the level is nearly the existing ground level.

Table-5.9 Minimum Floor Level

Town	Minimum Floor Level (above mean sea level)
Nausori	7.6 m
Sigatoka	2.5m
Nadi	6.0 m
Ba	5.0 m

Flood level of the cyclone Kina is roughly shown below. Inundated depth depends on location but generally about 1 m.

Table-5.10 Flood Level and Depth of Cyclone Kina

	Flood level (above mean sea level)	Inundated depth (Cyclone Kina, average)
Nausori	9 m	1.2 m
Sigatoka	6 m	1.8 m
Nadi	7 m	0.8 m
Ba	7 m	1.1 m

Therefore, new maps of flood prone area should be prepared and regulation of floor level or usage should be determined based on the maps.

3) Future Land Use in 2015

Based on the above policy, the future land use in 2015 was projected and the results is shown in Table-5.11 and Figure-5.8. Land use of Nadi town and its vicinity area shall be based on Nadi Town Planning Scheme which is prepared by the Department of Town and Country Planning.

Table-5.11 Land Use Projection in 2015

(km²)

Land Use	Rewa		Sigatoka		Nadi		Ba		Total of Watershed	
Forest	2,573	83 %	952	66 %	295	57 %	554	59 %	4,374	73 %
Conservation	2,164	70 %	719	49 %	248	48 %	399	43 %	3,530	59 %
Afforestation	409	13 %	233	16 %	47	9 %	155	17 %	(1) 844	14 %
Agriculture (Crop)	196	6 %	170	12 %	132	26 %	233	25 %	731	12 %
Grazing	296	10 %	327	23 %	69	13 %	136	15 %	828	14 %
Urban and Others	27	1 %	4	0 %	20	4 %	14	1 %	65	1 %
Total	3,092	100 %	1,453	100 %	516	100 %	937	100 %	5,998	100 %

Note: (1) including implementation after 2015

5.2.3 Land Tenure System and Land Use of Native Land

The land tenure system of Fiji is based on the traditional or customary social structure illustrated in Figure-5.9 (Tabua, 1995). Traditional Fijian social organization was standardized and is classified into Vanua, Yavusa, Mataqali and Tokatoka. Vanua is a group of people or tribe and embodies their belief and value. Yavusa is a sub-tribe or a clan. Mataqali is a sub-clan or land-owning group. Tokatoka is an extended family related group varying in composition from representatives of one household to several families. The head of Vanua, Yavusa and Mataqali is called Turaga-ni-Taukei, Turaga-ni-Qali and Turaga-ni-Mataqali, respectively. All ethnic Fijians are registered into their respective Fijian Social Unit (i.e. Yavusa, Mataqali, Tokatoka). These units can consist of a single person or several hundreds people and the owned land units range from zero to some thousands hectares. The average is some 240 ha. The numbers of the traditional and administrative groups or units are shown in Table-5.12.

Table-5.12 Number of Traditional and Administrative Groups

Division / Province	Administrative		Traditional			
	Tikina	Village	Vanua	Yavusa	Mataqali	Tokatoka
Central	55	331	64	416	1,745	3,024
Naitasiri	15	86	22	132	579	780
Namosi	5	26	3	21	72	134
Rewa	9	54	8	64	290	590
Serua	4	24	2	21	63	180
Tailevu	22	141	29	178	741	1,340
Western	62	322	67	399	1,418	2,974
Ba	21	107	20	147	402	1,050
Nadroga	22	122	25	110	346	679
Ra	19	93	22	142	670	1,245
Central & Western Total	117	653	131	815	3,163	5,998

Source : Information from Native Land Commission, 1993

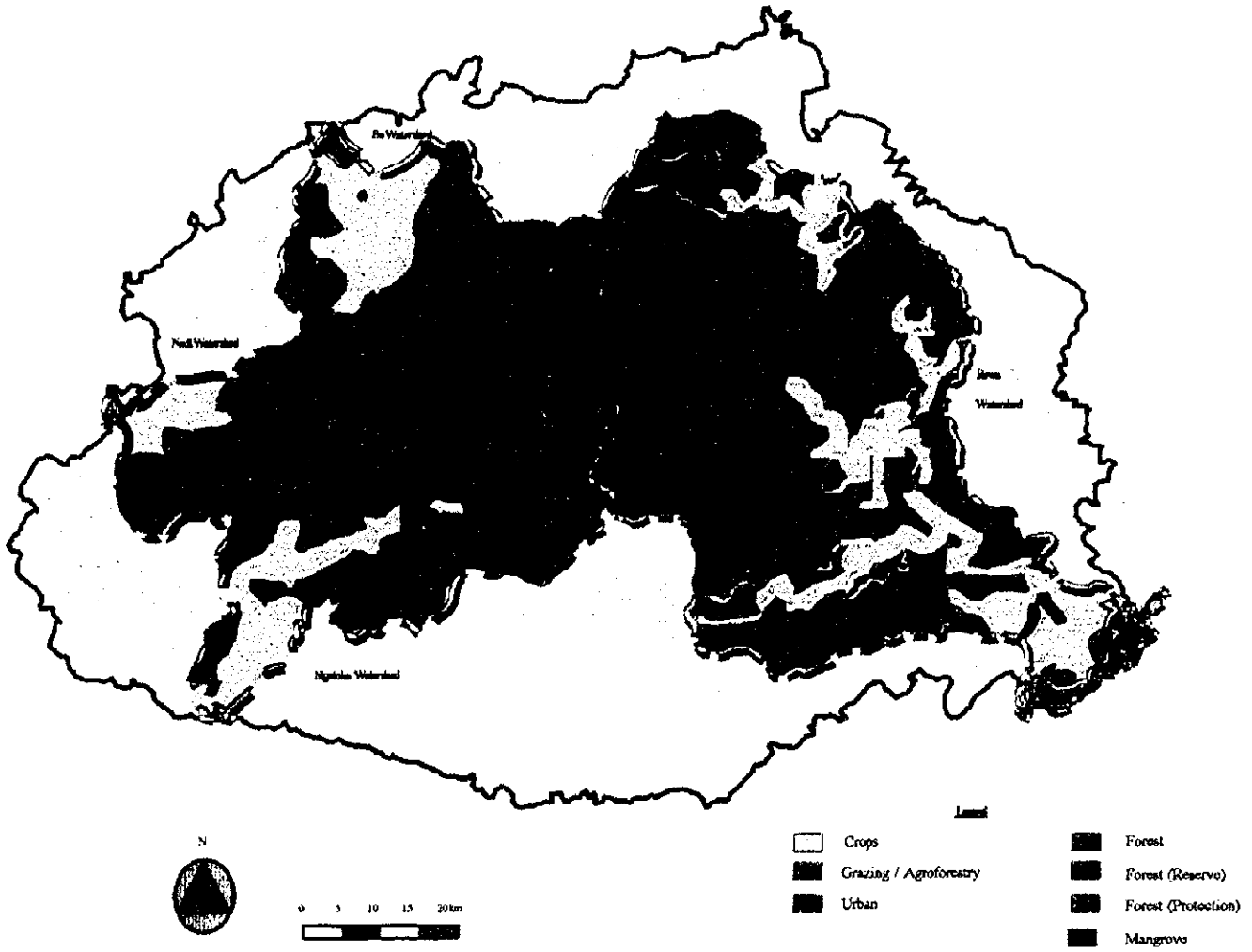


Figure-5.8 Future Land Use

The land tenure system was formalized during Sir Arthur Gordon's term and land was registered in accordance with the Sir Robert Torrens registration system. Through the efforts of various Native Land commissioners, every parcel of land has been surveyed and registered under the various proprietary group which includes the Mataqali or in some cases the Yavusa or Tokatoka or the state or private individuals, since 1874 when Fiji became a British colony.

NLTB was established in 1946 under the Native Land Trust Act, for the following objectives:

- to ensure the protection of the land interest of Fijian owners by reserving sufficient land for their own exclusive use
- to preserve continuity in land policy and security of tenure
- to obtain for the Fijian landowners adequate rents for their leasing land

The present distribution of the land tenure is shown in Table-5.13. The Native land amounts to 84 % of the total area of Fiji, the State land 9 % and the Free-hold land 7 %. The land tenure in the Viti Levu is shown in Figure-5.10.

Table-5.13 Land Tenure

Tenure	Area (ha)	%
Native Land	1,533,298	84 %
State Land	164,281	9 %
Free-hold Land	127,775	7 %
Total	1,825,354	100 %

Source : Native Land Trust Board , Estate Management

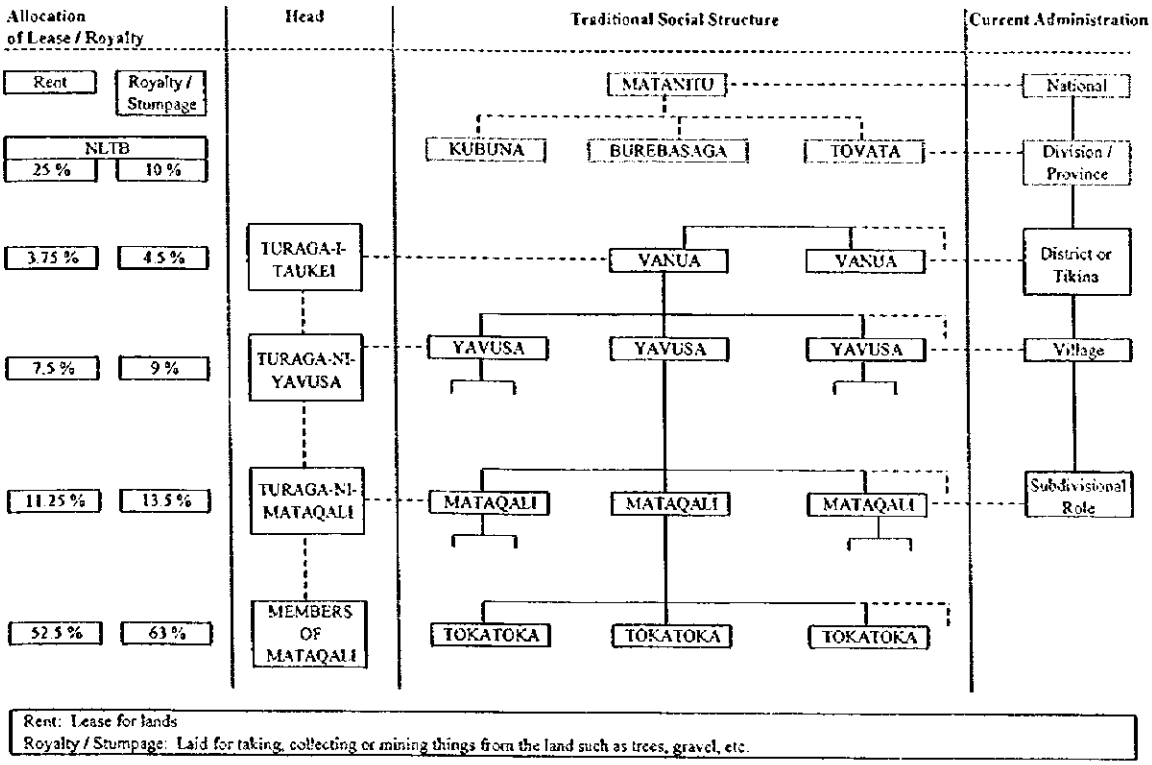


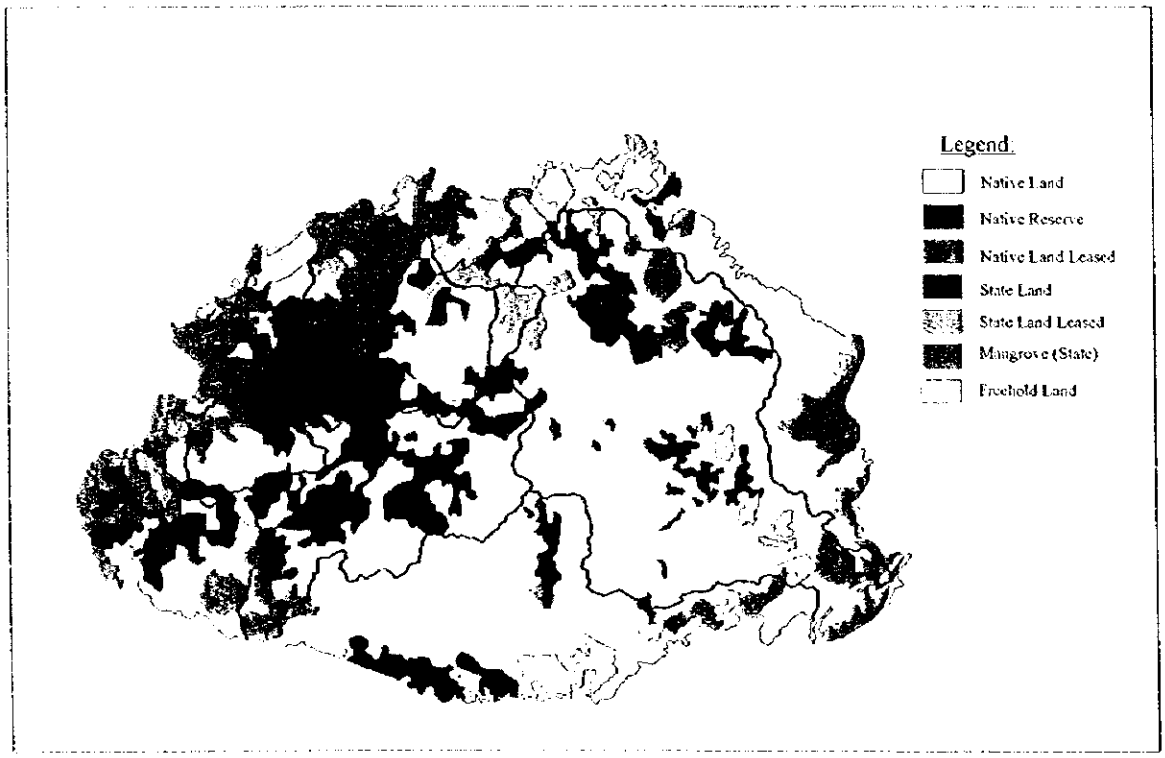
Figure-5.9 Traditional Social Structure and Allocation of Lease of Native Land

About one third (550,855 ha or 36 %) of the Native Land is designated as Native Reserve. The Native Reserve is retained for the use and support of the landowners, and shall not be leased without unanimous consent (basically more than 75 %).

The leased land in the Native Land amounts to 774,390 ha or 51 % of the Native Land or 42 % of the total land. The classification of lease is agricultural, residential, commercial, grazing, garden, dairy, tram-way, quarry etc. The dominant lease is "timber concession" (25 % to the Native Land). The forestry lease amounts to 32 %, including "Planned Pine Commission". The second is the agricultural lease comprising 19 % to the Native Land including ALTA and the Reserve.

The period of lease varies from a few years to 99 years for hardwood plantation etc. The period of "Agricultural Lease Class A" is 30 years. The standard prices for a lease are given according to the condition and classification of the land.

The NLTB is financed by 25 % of rents and 10 % of royalties or stumpage collected. The heads or the chiefs of Vanua, Yavusa and Mataqali take 5 %, 10 %, 15 % of the rest respectively. The members of Mataqali or equivalent receive the remaining. The use of the rent shares to the heads is at their discretion (Figure-5.9).



Source : FAO, 1989

Figure-5.10 Land Tenure

In addition to the fact that the land belongs to the Fijians traditionally, the land tenure system has the following advantages:

- Safeguarding the basis of living and the heritage
- Preventing monopoly of large landlords
- Preventing land speculation

The disadvantage of the system considered would be as follows:

- The tenants tend to seek for short term benefit neglecting long term maintenance and land degradation.
- For new land use, new lease should be required and making consent of the landowners is usually hard and time consuming.
- Strict control and punishment activities are lacking against the violators.
- Distribution of land to Mataqali is not averaged. Some have no land while some have inadequate land.
- Governmental requests for public benefit might be sometimes beyond control over the landowners.

The unique land tenure system should function for protection of disordered development and promotion of proper land use including conservation of natural forests etc. Although it would take time for the consent making, the system is playing an important role in development and conservation. In order to improve practicability, the procedure should be streamlined and the efficiency should be enhanced as well as promotion of the important projects.