

Effect of Irrigation on Soil and Ground Water in Ukai Right Bank Command of Surat District of Gujarat

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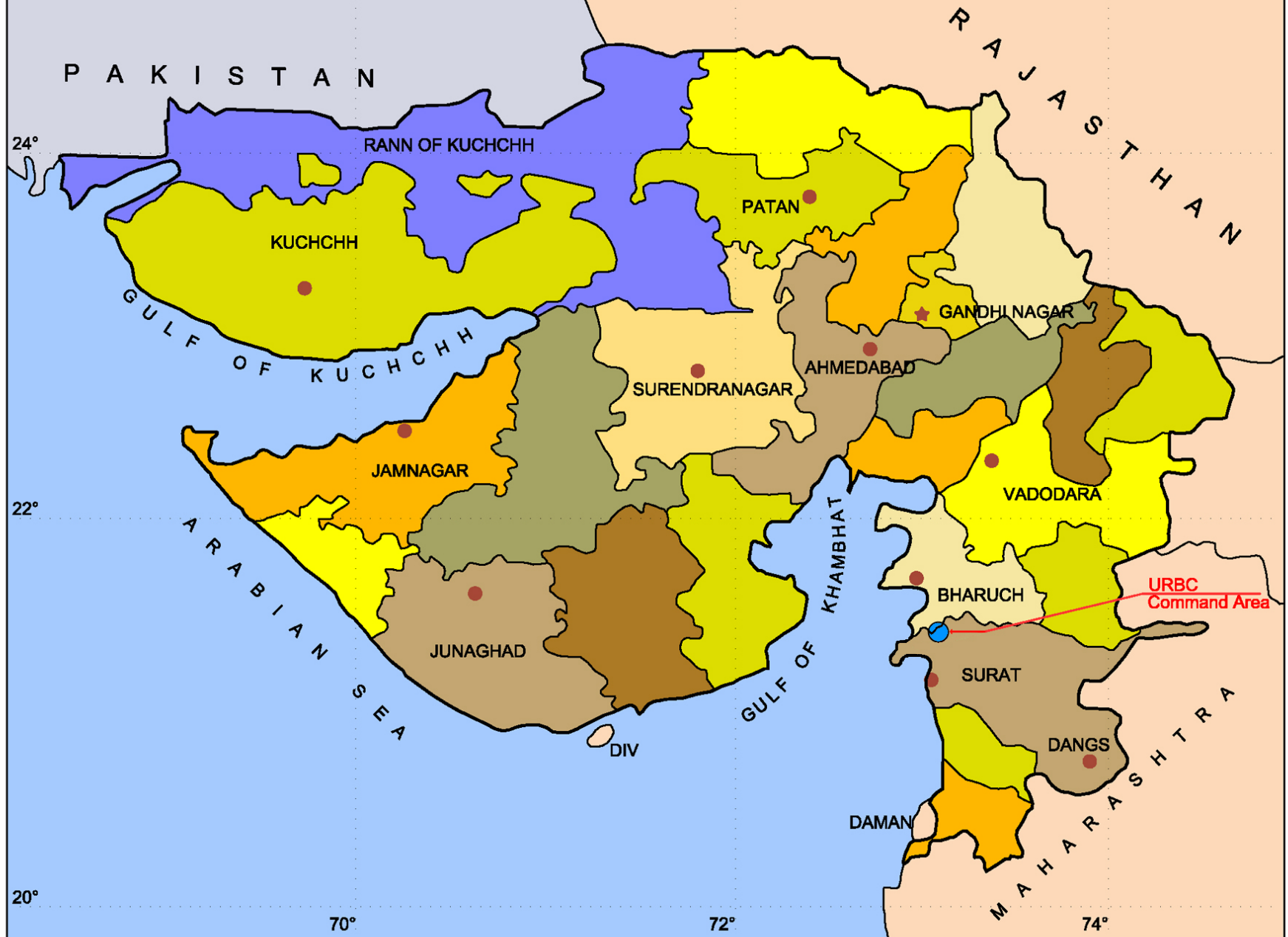
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MAP OF GUJARAT



Salient features of Ukai Reservoir Project

Location of dam : Village Ukai of Songadh
taluka of Surat district

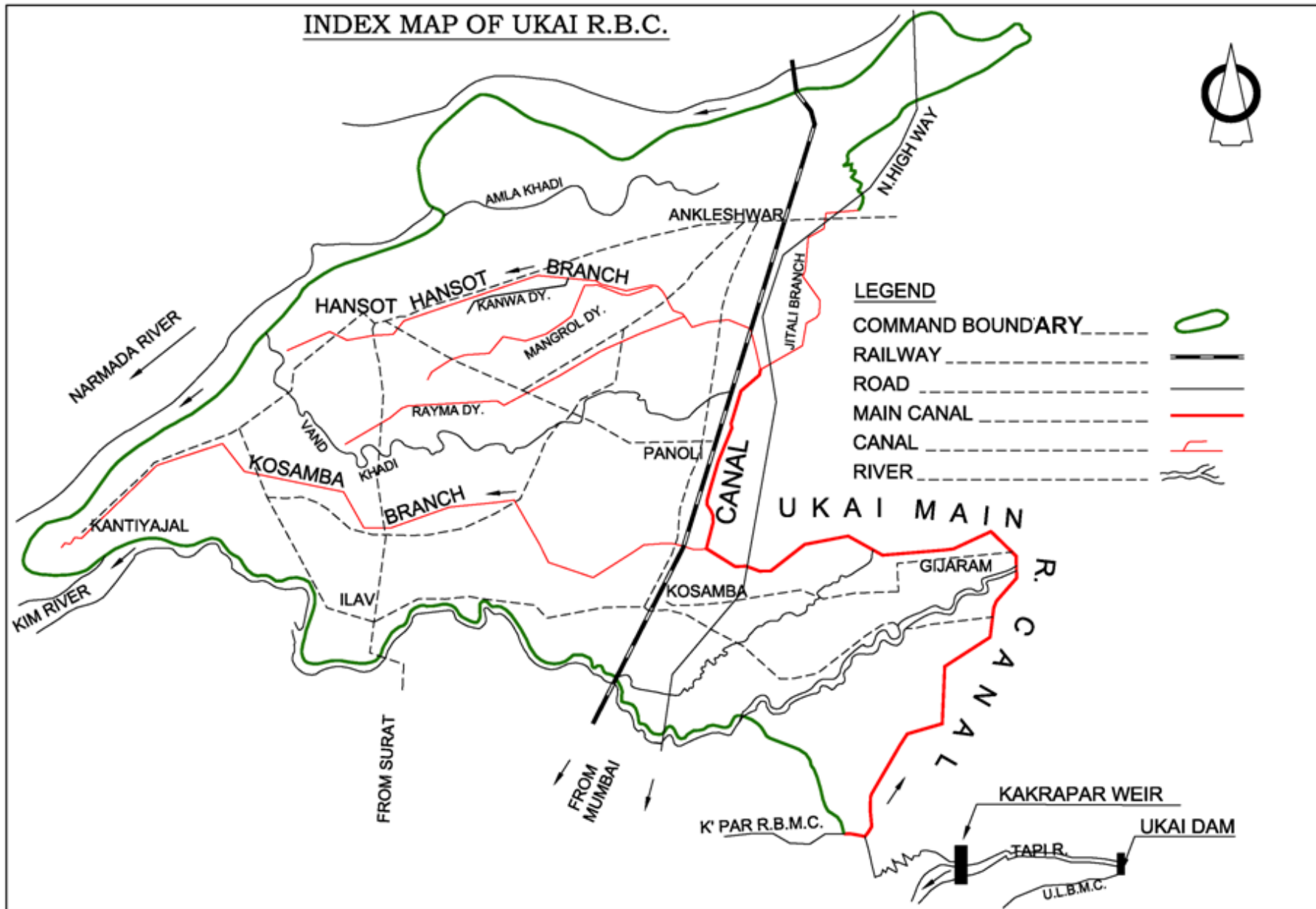
Reservoir :

Gross storage capacity at FRL	:	7414.29	MCM
Dead storage below RL 82.296 m	:	684.39	MCM
Live Storage	:	6730.00	MCM
Full Reservoir level	:	105.15	m
High flood level	:	106.99	m
Length of reservoir	:	112.00	km

Salient features of U.R.B.C.

- Total length of URBC is 48 km
- Design capacity 1590 cusecs
- Bed width of canal varies from 14.5 m to 7.5 m
- Full supply depth varies from 2.90 m to 1.25 m
- Side slope is 1:1
- Gradient of canal varies from 1:4000 to 1:6000
- The canal is unlined
- Gross Command Area 85873 ha
- Culturable command area 61309 ha
- 90 villages are irrigated

INDEX MAP OF UKAI R.B.C.



Importance of Soil Survey

- Pre-irrigation soil survey
- Post irrigation soil survey
- Comparison of properties of soil of pre-irrigation & post irrigation
- Changes in chemical properties in soil after prolonged irrigation
- Highlighting the areas where chemical properties is changed
- Maintenance of soil fertility
- Better agriculture planning

Importance of Sub Soil Water Table

- By taking pre & post monsoon observation of open wells in command area
- Ground water monitoring
- Depth of water level & quality of ground water
- Planning of agriculture & sub surface drainage

History of Surface Irrigation

- Traditional irrigation methods was being used before canal irrigation
- Canal water was introduced during year 1973

Earlier Investigation

- Detailed soil survey was carried out in U.R.B.C. command area during year 1964 before Surface Irrigation started (1973)
- Analysis of soil samples for following parameters were done
- EC, pH, M.A., Calcium Carbonate, M.H.C., Total Soluble Salt
- Soil texture & structure

Soil Salinity in year 1964

Soil salinity in %	Surface soil up to 90 cm		Subsurface Soil more than 90 cm	
	ha	%	ha	%
Less than 0.20	59338	69.1	50768	59.1
0.20 to 0.50	19321	22.5	21683	25.3
0.50 to 0.80	3006	3.5	5668	6.6
Above 0.80	4208	4.9	7754	9.0
Total	85873	100.0	85873	100.0

Soil salinity was computed in %

Ref. : Agriculture Handbook No. 60 - USDA

Ground Water Table

Range of ground water level in m	Area	
	ha	%
Within 3.0	8587	10.0
3.0 to 4.5	38042	44.3
4.5 to 6.0	20266	23.6
6.0 to 7.0	16058	18.7
More than 7.0	2920	3.4
Total	85873	100.0

Ground Water Quality

- **EC (Salinity):**

**Out of 409 water samples,
14 % samples had salinity
more than 3000 micromhos/cm**

- **Area with saline ground water
was scattered over the command**

Cropping pattern

- Rainfed agriculture
- Major crops: Cotton, Juwar, Pulses
- No perennial crops during year 1964

Present investigation (1991 to 1999)

- **To study effect after prolonged irrigation & cultivation of perennial crops**
- **Detailed soil survey was carried out in U.R.B.C. area after 18 years of surface irrigation**
- **Analysis of soil samples for the following parameters:**

EC, pH, M.A., M.H.C., Calcium Carbonate, C.E.C., Exchangeable Sodium & Potassium

Study of ground water quality

- Every year monitoring of ground water quality. (Pre & Post Monsoon)
- Monitoring of ground water quality is being carried out since year 1979
- Water sample analysed for different parameters such as Salinity, Alkalinity & soluble Cations - Anions

Soil Salinity

Salinity range millimhos/cm	Area			
	0 to 90 cm		More than 90 cm	
	ha	%	ha	%
Less than 1.0	40092	46.7	30233	35.2
1.01 to 1.50	10437	12.2	14862	17.3
1.51 to 2.50	13663	15.9	14910	17.4
2.51 to 3.00	5017	5.8	4734	5.5
More than 3.0	15964	18.6	19771	23.0
Total	85173	99.2	84510	98.4
Area under GIDC	700	0.8	700	0.8
Grand Total	85873	100.0	85873	100.0

Soil salinity is considered in millimhos/cm

Ref. : IS - 5510

Ground Water Table

Year of observation pre - monsoon	Ground Water Table in m							
	0 to 1.5		1.5 to 3.0		3.0 to 6.0		More than 6.0	
	ha	%	ha	%	ha	%	ha	%
1976	130	0.2	5528	6.4	52821	61.5	27394	31.9
1979	13	Neg.	5494	6.4	62256	72.5	18110	21.1
1989	2152	2.5	21652	25.2	52931	61.7	9138	10.6
1999	2147	2.5	32785	38.2	44707	52.1	6234	7.2
2009	1260	1.5	33530	39.0	39038	46.0	12045	14.0

Ground Water Quality

Year of observation pre - monsoon	Ground water quality in micromhos/cm							
	0 to 1000		1000 To 2000		2000 To 3000		More than 3000	
	ha	%	ha	%	ha	%	ha	%
1979	17260	20.1	56735	66.1	3205	3.7	8673	10.1
1989	7651	8.9	60674	70.7	11619	13.5	5929	6.9
1999	3480	4.1	55032	64.1	22396	26.0	4965	5.8
2009	Nil	Nil	435	0.5	55480	64.5	29958	35.0

Existing Cropping Pattern

- Cropping pattern has changed
- At present cash crops like Cotton, Sugarcane, vegetable and perennial crops are grown

Base assumption of soil salinity data

- In early age, soil salinity was computed in percentage
- Range of salt percentage expressed as less than 0.2, 0.2 to 0.5, 0.5 to 0.8, more than 0.8
- At present, soil salinity is computed in millimhos/cm
- Range of salinity less than 1.0, 1.0 to 1.5, 1.5 to 2.5, 2.5 to 3.0 & more than 3.0 millimhos/cm
- $\% \text{ salt} = 0.064 \times \text{EC millimhos/cm}$
- $1 \% \text{ salt} = 10,000 \text{ ppm}$
 $= 15.62 \text{ millimhos/cm}$
 $= 15620 \text{ micromhos/cm}$

Comparison of earlier & present investigation

- **No change found in soil texture**
- **Soil structure is changed from soft, granular to hard & massive**
- **Saline area having EC more than 1.5 millimhos/cm has increased from 30.9% to 52.5%**
- **Raised ground water table (gwt)**

Rise of gwt :

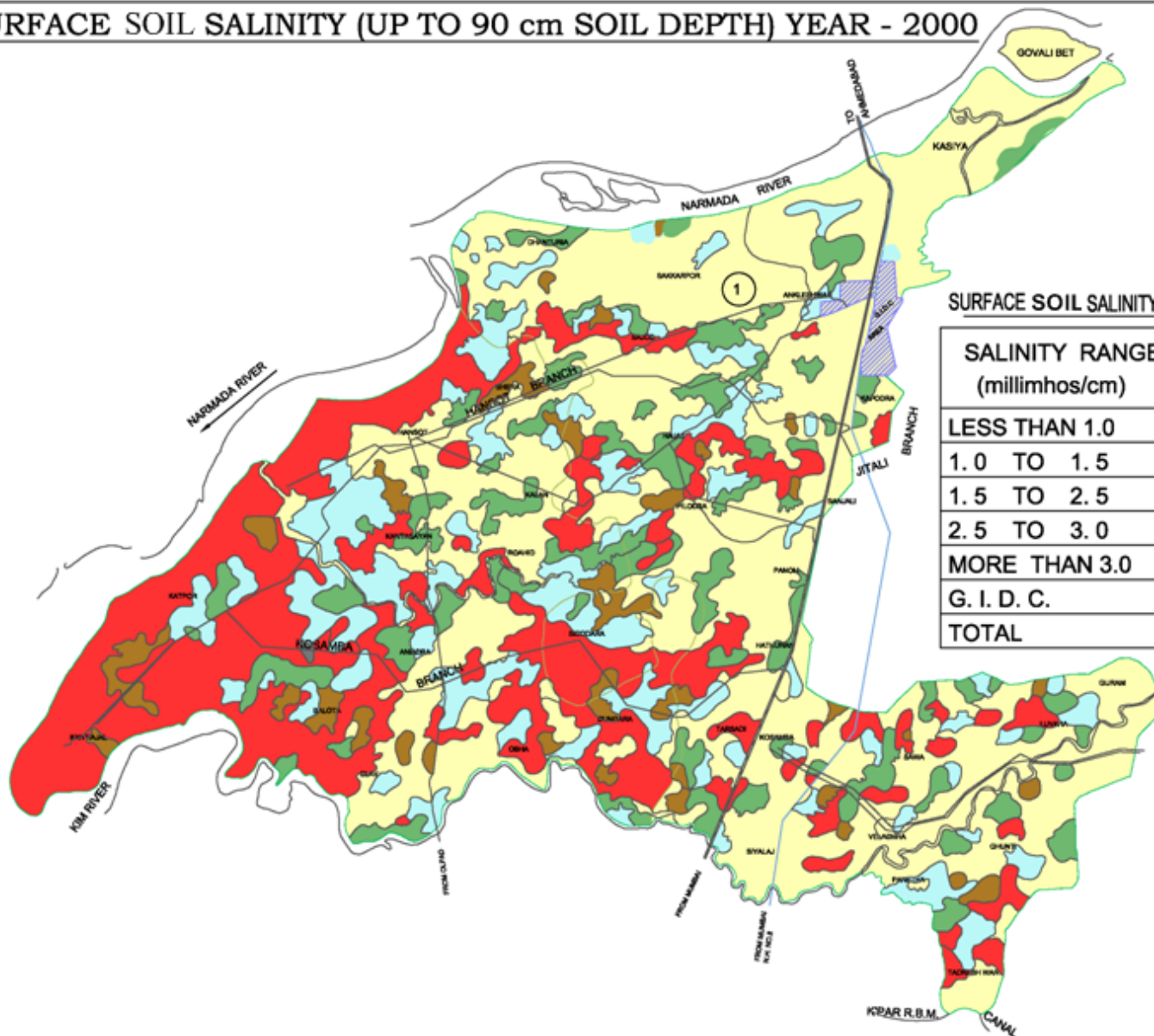
Sr.	Year	% area having gwt within 3.0 m
1	1976	6.6
2	1979	6.4
3	1989	27.7
4	1999	40.7
5	2009	40.5

- Earlier only rainfed farming was being done -
Crop: Cotton, Juwar, Pulses
- Presently irrigated farming is being done-
Crop: Cotton, Sugarcane, Vegetable & perennial crops

Ground Water Quality

Sr. No.	Year	% area having EC more than 2000 micromhos/cm
1	1979	13.8
2	1989	20.4
3	1999	31.8
4	2009	99.5

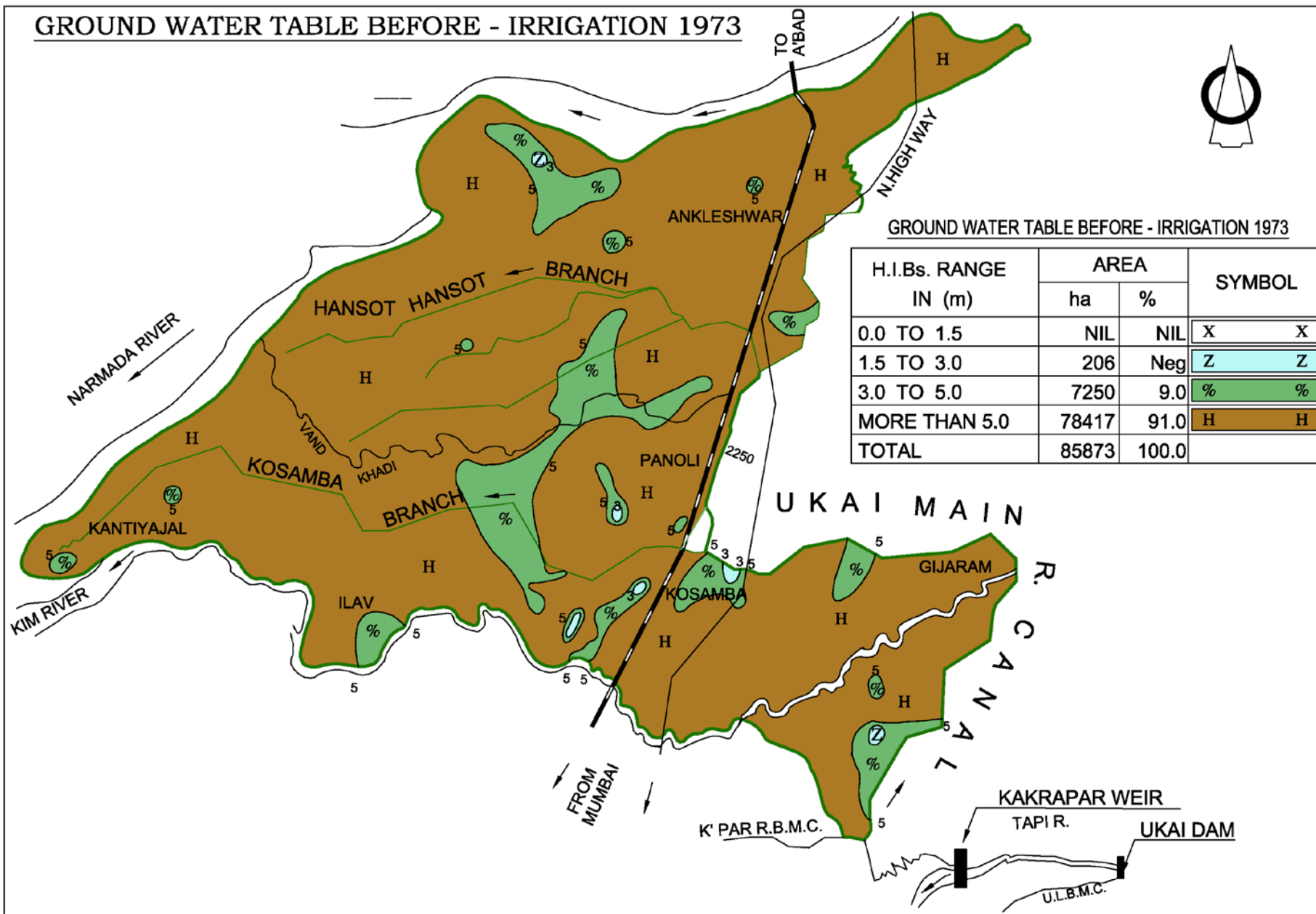
SURFACE SOIL SALINITY (UP TO 90 cm SOIL DEPTH) YEAR - 2000



SURFACE SOIL SALINITY (UP TO 90 cm SOIL DEPTH) YEAR - 2000

SALINITY RANGE (millimhos/cm)	AREA		SYMBOL
	ha	%	
LESS THAN 1.0	40092	46.7	
1.0 TO 1.5	10437	12.2	
1.5 TO 2.5	13583	15.8	
2.5 TO 3.0	5017	5.8	
MORE THAN 3.0	16044	18.7	
G. I. D. C.	700	0.8	
TOTAL	85873	100.0	

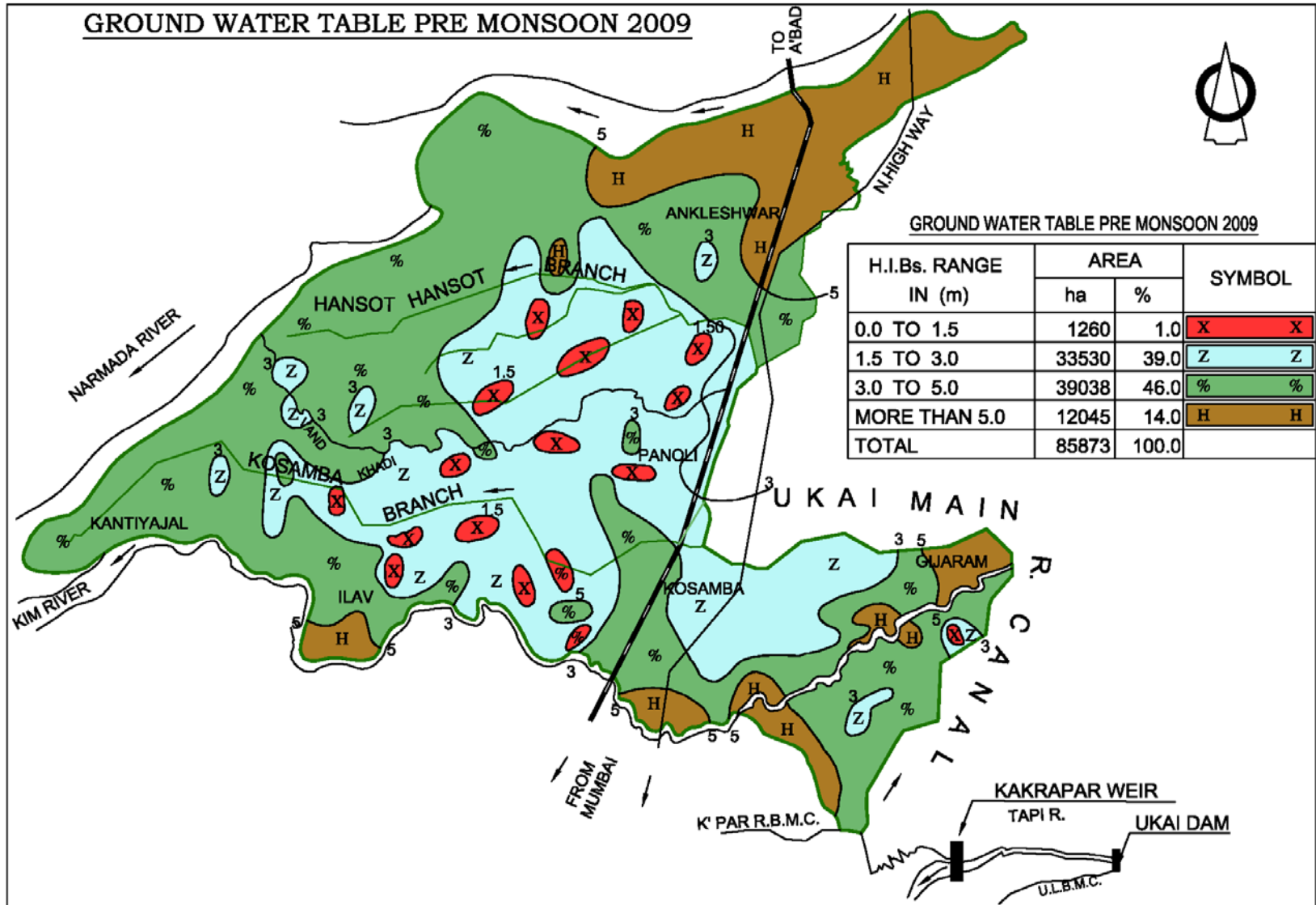
GROUND WATER TABLE BEFORE - IRRIGATION 1973



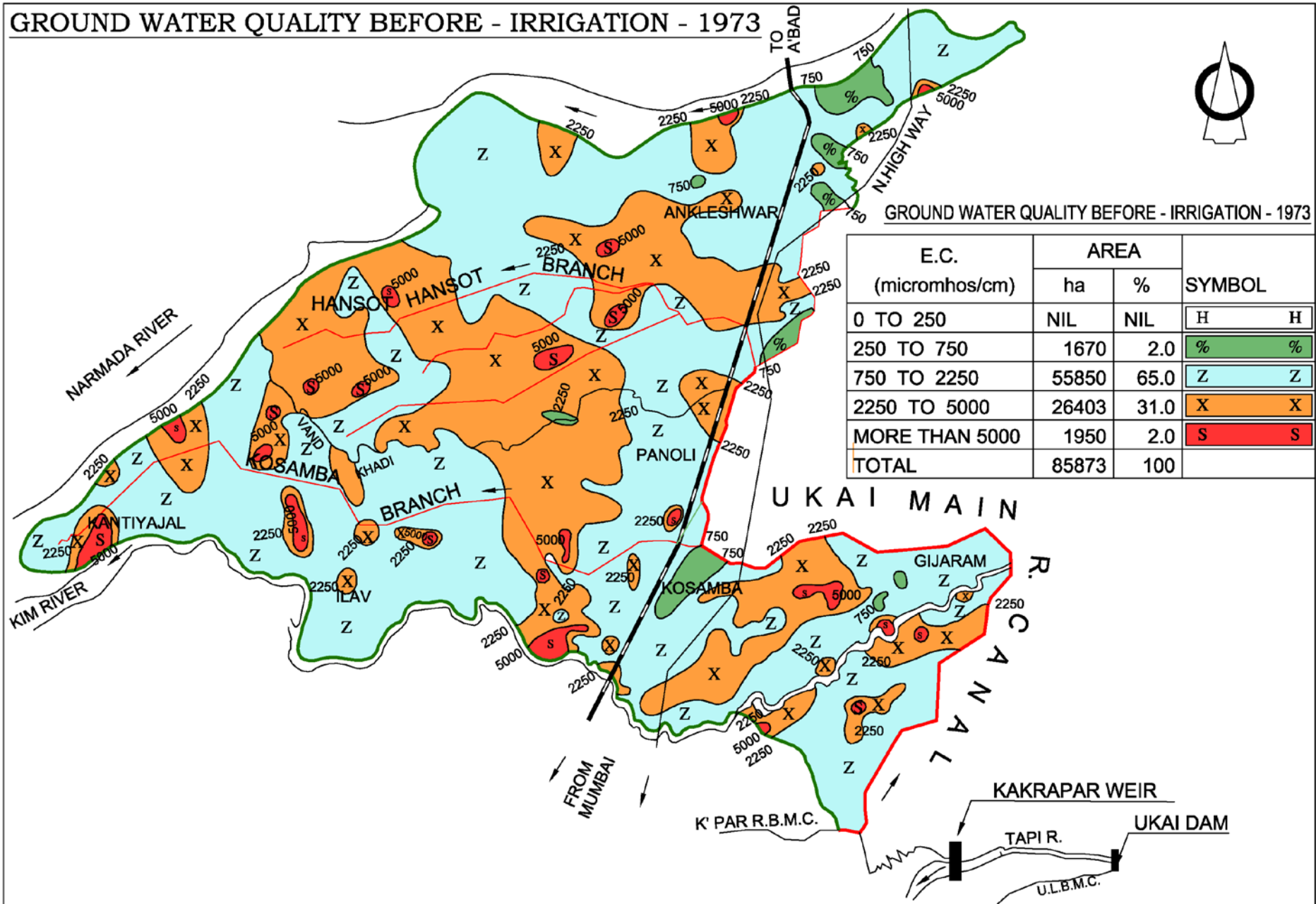
GROUND WATER TABLE BEFORE - IRRIGATION 1973

H.I.Bs. RANGE IN (m)	AREA		SYMBOL	
	ha	%		
0.0 TO 1.5	NIL	NIL	X	X
1.5 TO 3.0	206	Neg	Z	Z
3.0 TO 5.0	7250	9.0	%	%
MORE THAN 5.0	78417	91.0	H	H
TOTAL	85873	100.0		

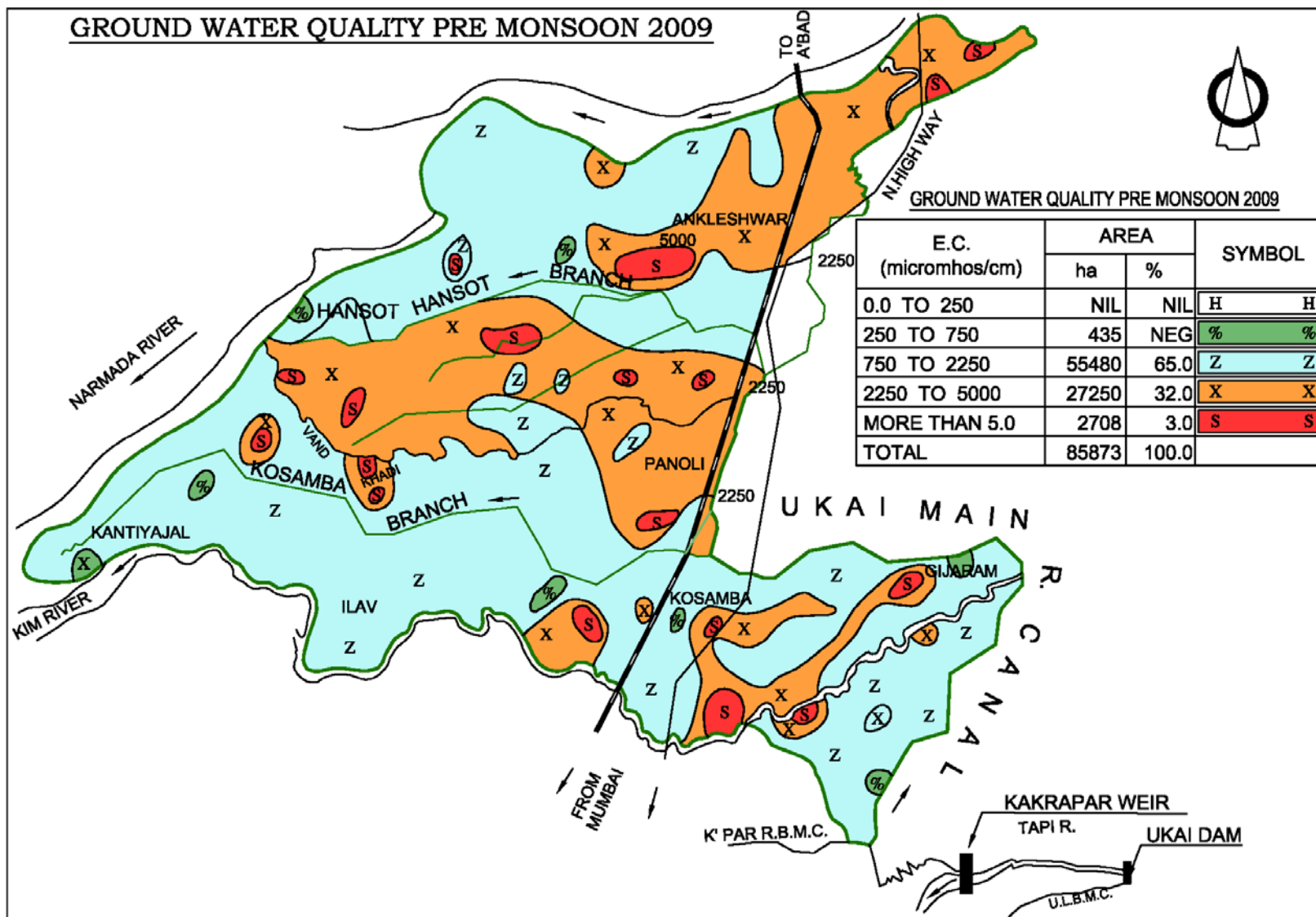
GROUND WATER TABLE PRE MONSOON 2009



GROUND WATER QUALITY BEFORE - IRRIGATION - 1973



GROUND WATER QUALITY PRE MONSOON 2009



Conclusion

- **Soil salinity has increased**
- **Ground water table has risen**
- **Quality of ground water is deteriorating**
- **Problems arised due to excess irrigation**

Important recommendations in soil survey report to concerned project authority

- **Lining of canal to minimize waterlogging through seepage**
- **Canal water & well water to be used alternatively**
- **Adequate surface & sub surface drainage to leach down soluble salts & to lower ground water table**
- **Restriction in perennial crops**

- **Addition of Gypsum (Chirodi) where soil is alkaline**
- **Adoption of micro irrigation system like drip, sprinkler etc.**
- **Control in chemical fertilizers**
- **Use more compost & green manuring**
- **Adoption of salt tolerant crops in saline soil**

Salt tolerant crop varieties:

- **Paddy- Jaya, SLR 5,12,14**
- **Cotton- Kalyan, V- 797, Sanjay**
- **Sugarcane- C-205, C-286, C-834, C-853, C.A.-7602**
- **Wheat- Kharachiya, Popatiya, Arnej**
- **Juwar- C-10-2**

Thanks