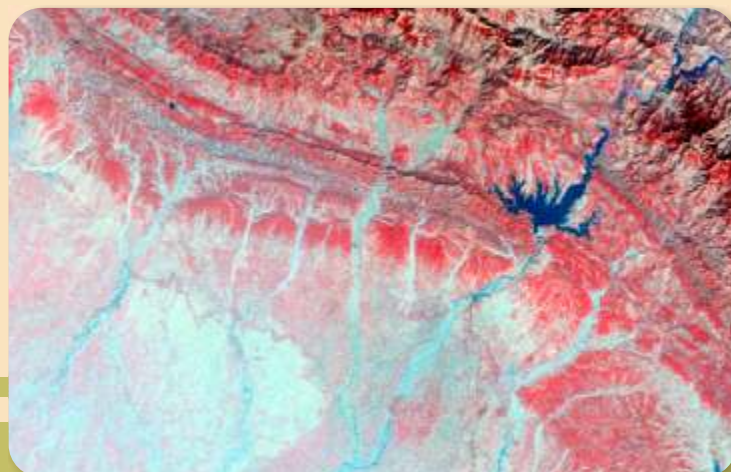




Bulletin 4/2007

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A Systematic and Scientific Compilation



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Tel. : +91-184-2290501, Gram : Salinity, Fax : +91-184-2290480

Email : director@cssri.ernet.in, Website : www.cssri.org

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*Salt is the flavour of the ocean
when it becomes flavour of land
it spells trouble for the
Tiller, Miller and the Ruler*

EXTENT OF SALT AFFECTED SOILS IN JAMMU AND KASHMIR

A Systematic and Scientific Compilation

R.C. Sharma¹, Gurbachan Singh¹, R.K.Sharma² and V. Sharma²

1. CSSRI Karnal, 2. SKUAST Jammu

Occurrence of salt affected soils in Jammu region is mainly confined to canal commands. Ranbir Canal was commissioned about 100 years ago to irrigate Ranbir Singh Pura area of Jammu bordering Pakistan. The extent of salt affected soils in tehsil Ranbir Singh Pura is 10,000 ha. Later on Ravi-Tawi Canal system was completed in 1978 to irrigate areas in Jammu and Kathua districts. Within 20-25 years salt affliction appeared at several places and covered an area of 7,500 ha. Thus total salt affected area in Jammu and Kathua region adds up to 17,500 ha.

INTRODUCTION

Nationwide mapping of salt affected soil (SAS) in India was completed by NRSA and Associates (1996) to report an area of 67,27,468 ha in 14 states and one Union Territory. They mapped the areas, which had a long history and serious problems of salts. The other states blessed with high rainfall and well developed drainage etc where possibilities of soil salinity appeared remote were left out. However, agricultural and irrigation developments made a marked shift in land uses that led to emergence of salinity hot spots in new areas. To bring such areas on the salinity map of India, the CSSRI Karnal, have taken up the task to scientifically scrutinize and compile the available information. The state of Jammu and Kashmir is the first attempt in this direction.

JAMMU AND KASHMIR

Jammu and Kashmir with three prominent Divisions of Leh-Ladakh, Kashmir and Jammu is the northern state of India. High mountains and narrow valleys with extremely cold climate are characteristics of Leh-

Ladakh and Kashmir. While few instances of dry land salinity has been reported in Leh-Ladakh there has been no reports of soil salinity in Kashmir Division. Jammu Division falls under sub mountainous undulating landscape with extremely cold winters and hot summers. Several reports in the recent times have emerged to report the occurrence of salinity in the Ravi-Tawi Canal Command covering *Kandi* belt in Jammu-Kathua region.

JAMMU-KATHUA REGION

During pre independence, the Jammu-Kathua region known as *Kandi* belt was full of wild vegetation. It had many enclosures and *Rakhs*, which were strictly guarded by Forest Guards under Maharaja's rule. As a result the whole *Kandi* belt was lush green and a lovable abode for wild animals. After independence *Kandi* belt came under large-scale encroachments. The wood was cut, wild animals were killed, houses and rural infrastructures came up resulting in continuous deforestation and loss of vegetation. Population started increasing and the pressure on land and water resources increased. Tanks, wells and *Chhapers* started drying and cultivation of crops became extremely difficult to threaten agricultural sustainability. The satellite image (Plate 1) shows

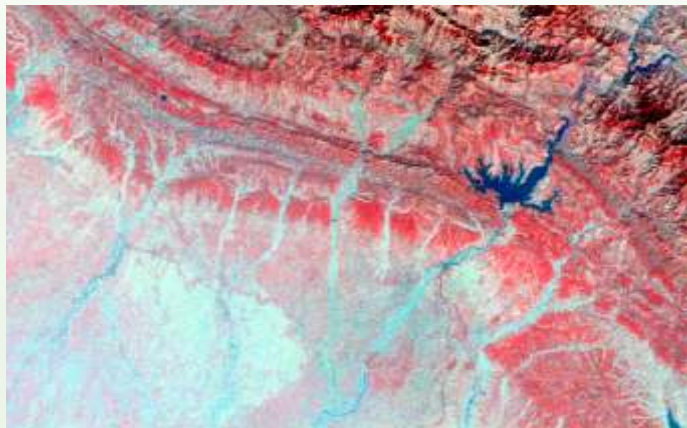


Plate.1.Satellite image of *Kandi* area showing water reservoir (blue) and eroded areas (light grey)

the highly eroded and dilapidated state of *Kandi* belt. In late sixties, advent and introduction of new crop varieties like Mexican Wheat, Hybrid Maize, Jowar and Barley supported by crash programmes and scientific methods of crop husbandry yielded desired recovery in agricultural production. In seventies, Ravi-Tawi Canal was commissioned to irrigate the parched cultivable areas, which further triggered agricultural development in *Kandi* belt.

RAVI-TAWI CANAL COMMAND

The first component of Ravi-Tawi Canal was Tawi Lift Scheme located on Tawi River at Bahu Fort, Jammu, which was started in 1978. With 300 cusecs of water it covered an area of 12,800 ha. The second component viz; Ravi Canal from river Ravi at Lakhanpur, Basantpur and Shahpur barrage was also commissioned simultaneously with 1150 cusecs water to irrigate 53,900 ha area. Thus, the combined Ravi-Tawi Canal irrigates 66,700 ha area. Simultaneously, Command Area Development Programme was also started to optimally utilize irrigation potentials in the area. Small sized holdings averaging around 1.30 ha usually remained unutilised due to uneven and eroded nature of the land. Land leveling/reshaping and terracing (Plate 2) resulted in increasing per unit cultivable area for the command farmers.



Plate.2. Undulating areas have been reshaped into terraces in the Ravi-Tawi command

IMPACT OF CANAL IRRIGATION ON AGRICULTURE

The Ravi-Tawi canal irrigation made a significant impact in *Kandi* belt and considerably changed the landuse of the area (Plate 3). The cropping pattern changed from low water to high water requirement crops. Crops like Maize, Sorghum, Til, Moth, Mash, Moong, Bajra, Cotton, Wheat, Barley, Oats, Mustard and Linseed gave way to Paddy, Maize for green cobs, Gobi Mustard, Potato, Wheat, Berseem, Mushroom and vegetables.

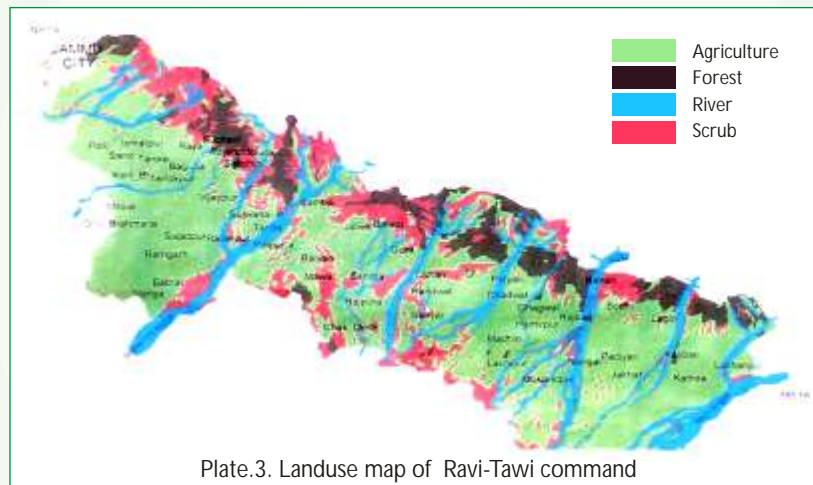


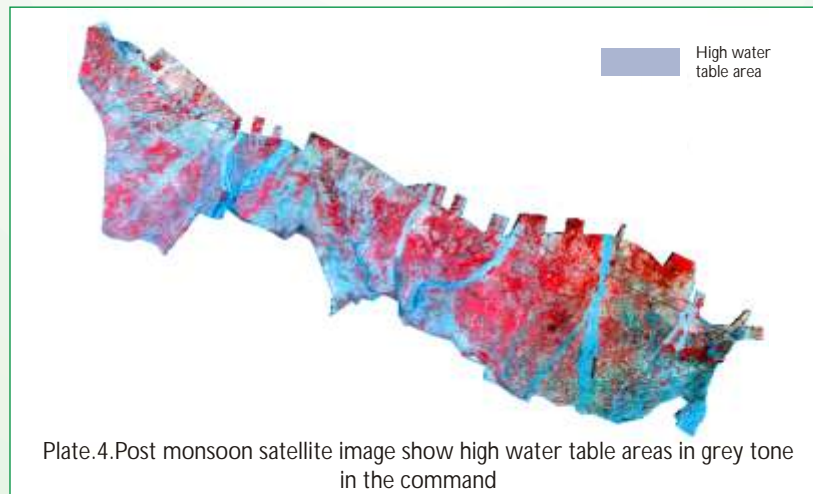
Plate.3. Landuse map of Ravi-Tawi command

Productivity in Quintals per hectares for various crops increased manifold from the year 1975 to 1998 viz; Paddy yield increased from 12 to 39.2; Maize from 15 to 24; Wheat from 10 to 35; Oil seeds and Pulses from 4 to 7. Introduction of vegetables and summer fodders including legumes, Moong/Mash etc improved the rotational efficiency and soil health. Cropping intensity increased to 183%. Improved seed distribution for all crops increased from 4763 Quintals in 1981 to 6075 Quintals in 1999. Fertilizer consumption increased from 4153 MTs in 1981 to 10345 MTs in 1999. Fertilizer consumption per hectare increased from 60 kg in 1981 to 86 kg in 1999. Area coverage under

various crops increased in cropping seasons of Kharif from 30,600 ha to 51720 ha and in Rabi from 43400 ha to 72100 ha between the years 1987 to 1999. Thus, the canal irrigation brought manifold increase in agricultural productivity of *Kandi* belt.

SOIL AND WATER MANAGEMENT

Immediately after commissioning the canals a Soil and Water Management Project was started in 1979 with the purpose to educate and demonstrate the command farmers the rational use of scarce natural resources like land, soil and water. The command faced problems of overuse of water by head reach farmers and low water supply at tail reaches. Enhanced seepage and percolation through *Kaccha* watercourses caused nearly 60% water loss from main canal to farm gate. These resulted in water logging and development of soil salinity/alkalinity. At few places, corrective measures like lining of field channels and application of gypsum were practiced to check field conveyance losses of water and reclaim alkaline soils. Tapping of ground water for conjunctive water use was at low scale. Lesser number of pumps 30 in 1987 to 838 in 1999 falls short to check rising water tables in the command (Plate 4).



OCCURRENCE OF SALINITY AND ALKALINITY IN THE COMMAND

Prior to the commissioning of Ravi-Tawi irrigation system, *Kandi* belt used to receive massive run off and sediments from the nearby mountains. Distinct land gradients and numerous rivulets quickly transported the run off mass to Punjab plains to save the *Kandi* belt from long duration inundation. Large scale soil conservation measures of land shaping, land filling, terracing, field bunding and other development activities like construction of roads, railways, canals, distributaries, field channels, and embankment etc, altered the top-slope to restrict the natural drainage. This caused increased incidences of water logging, water table rise and soil salinisation (Plates 5&6). According to status report of the Directorate of Command Area Development, Jammu (2000), the command witnessed an increase in water logging from 3000 ha to 12,000 ha and soil salinity from 250 ha to 1000 ha in a period of 20 years.

The ensuing poor natural drainage and rising water tables gradually changed the soil moisture regime to accelerate weathering and release



Plate.5. Waterlogging and salinisation are evident by moistened soil in the foreground and salt appearance on the field cuts



Plate.6. Low lying areas are the first to be waterlogged and salinised

of salts from soil minerals. The salts in soil solution moved and accumulated in the lower land concavities under the influence of prevailing geo-hydro-climatic conditions (Plate.7). In a recent survey of Ravi-Tawi command using Landsat image Jalali et al (2004) found emergence of salt affected soils in several villages like; Mathra-Chak, Dyala-Chak, Badala, Taror, Nagri etc. The salt affected soils also occurred in tehsils, Gho, Shazadpur, Samba, Rajpura and Kathua.



Plate.7. Water table rise (dark grey tone) leads to accumulation of salts (white) on soil surface

Appearance of salts on field cuts and bunds indicate the solubilisation, movement and accumulation of salts in soil profile. At many places,

poor germination of wheat signifies root zone salinity, which might spread to larger areas in the years to come. Depth wise data from several villages (Table 1) show high salt concentration in soil solution. EC_2 of more than 1.5 dS/m at 1-meter soil depth is likely to accelerate soil salinisation/alkalisation processes under rising water table as the case in village Mathra Chak. Moreover, pH values of more than 8.5 and ESP more than 15 indicate the formation of sodic soils.

Table 1. Characteristics of salt affected soils from several villages in Ravi-Tawi command

Location	Soil depth (cm)	PH_2	EC_2 dS/m	ESP
Dyala Chak	0-20	8.6	0.75	19.4
	20-80	8.4	0.95	17.0
	80-100	8.4	1.58	15.2
Salni	0-20	8.6	0.55	19.7
	20-80	8.3	0.95	17.0
Khokyal	0-20	8.6	0.55	19.0
	20-80	8.3	1.35	17.5
	80-100	8.0	0.60	13.2
Mathra Chak	0-20	9.0	0.75	32.5
	20-80	8.7	0.90	24.5
	High water table	--	--	--
Bir Chak	0-20	8.5	0.75	17.6
	20-80	8.6	1.10	17.0
	80-100	8.5	1.76	15.5
Badala	0-20	9.0	0.30	28.2
	20-80	8.8	0.75	22.4
	80-100	8.7	1.30	18.5
Nagri	0-20	8.6	0.55	18.4
	20-80	8.5	1.00	16.7
	80-100	8.4	1.40	15.7

Source: Jalai et al (2004)

Formation and Characteristics of Salt Affected Soils: The salt affected soils (Table 2) with pH value 9.7 and ESP 47 are alkali in nature

and have been developed primarily through weathering of plagioclase feldspar through hydrolysis and carbonation processes. Synthesis of sodium carbonate primarily through weathering is followed by several reactions like cation exchange leading to saturation of most exchange sites in the profile with sodium, precipitation of calcium and magnesium as carbonates, and hydrolysis of exchangeable sodium during infiltration of water further augment formation of sodium carbonate.

Table 2. Alkali soil profile at village Tarore in Jammu district

Soil depth (cm)	pHs	EC ₂ dS/m	ESP	Water soluble (me/l)	
				Na	CO ₃
0-20	9.7	0.24	47.0	8.7	3.8
20-40	9.6	0.25	38.9	7.4	3.0
40-60	9.1	0.19	15.5	2.0	2.4
60-100	8.1	0.17	14.0	1.6	2.2

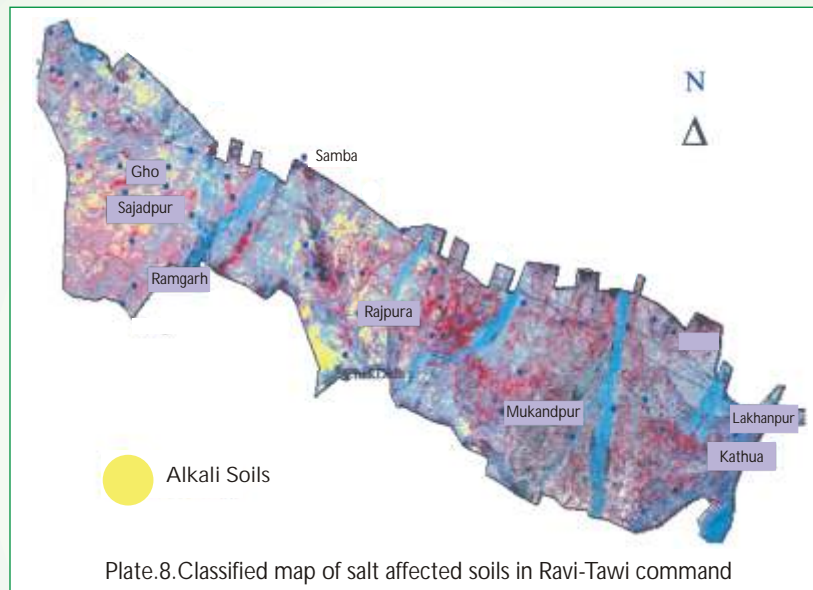
Source: Jalai et al (2004)

The alkali soils not only have adverse chemical and physico-chemical characteristics for plants but are also poor in soil-tilth due to high pH (>8.5) and higher ESP (>15). They also remain highly dispersed and impermeable to both water and air. The infiltration rate decreases due to sealing of water conducting pores. These soils can be tilled over a very narrow moisture range. Higher soil pH in alkali soils renders plant nutrients like phosphorus, zinc, manganese and iron unavailable and molybdenum, boron and carbonates in toxic limits. To restore productivity of alkali soils it is necessary to reclaim them with amendments like gypsum etc.

EXTENT OF ALKALI SOILS IN JAMMU REGION

Commissioning of Ravi-Tawi canal increased the incidences of salt affected soils in the command. According to the reports of Directorate of Command Area Development, Jammu (2000) irrigation has increased area under water logging from 3000 ha to 12,000 ha and

under soil salinity from 250 ha to 1000 ha in Ravi-Tawi Command. The department of Soils in Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu in the project on Impact of Ravi-Tawi irrigation on soil health of sub-tropical zone of Jammu region by Jalali et al (2004) have reported nearly 25,000 ha area suffering from land degradation of salts, wastelands (eroded lands) and waterlogging.



The report does not give any breakup of area under three categories but has shown their polygon distribution on a small-scale map. Visual interpretation of multicoloured map indicate the spatial extent in the proportion 1: 2.5:1.5 for wastelands: water logging : salt affected soils. Thus the area under each category measure to 5,000: 12,500 : 7,500 ha. The figure of 12,500 ha water logged area is well comparable with the 12,000 ha area reported by the Command Area Development, Jammu. Thus, the salt affected area in Ravi-Tawi command measures to 7,500 ha (Plate 8). Ranbir Singh Pura tehsil of Jammu district is under irrigation through Ranbir Canal for more than 100 years where occurrence of salts is a common phenomenon. Nazar (1991) have reported 10,000 ha salt affected soils in Ranbir Singh Pura tehsil of

Jammu district. Thus by adding 7,500 ha under Ravi-Tawi command and 10,000 ha under Ranbir Canal command total salt affected area in Jammu division of J&K adds up to 17,500 ha. Construction of a recent dug-bund across the international border by Pakistan has interrupted drainage, which has further caused water logging and salinity in the area. Table 3 gives the state wise extent of salt affected soils in India.

Table 3. State wise extent of salt affected soils in India (ha)

<i>State</i>	<i>Saline</i>	<i>Sodic</i>	<i>Total</i>
Andhra Pradesh	77598	196609	274207
Andaman & Nicobar Island	77000	0	77000
Bihar	47301	105852	153153
Gujarat	1680570	541430	2222000
Haryana	49157	183399	232556
Karnataka	1893	148136	150029
Kerala	20000	0	20000
Madhya Pradesh	0	139720	139720
Maharastra	184089	422670	606759
Orissa	147138	0	147138
Punjab	0	151717	151717
Rajasthan	195571	179371	374942
Tamil Nadu	13231	354784	368015
Uttar Pradesh	21989	1346971	1368960
West Bengal	441272	0	441272
Total	2956809	3770659	6727468
Jammu & Kashmir	--	17,500	17,500

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