

Monitoring Of Water Logged Areas in Krishana Canal Command Using Gis Techniques

Dr. Santosh Bhailume¹, Dr. Vasant Wagh² Dr. Ravi Kumar³

¹Assistant Professor, Department of Geography, KVN Naik College, Nashik.

²Associate Professor and Head, Department of Physics, KVN Naik College, Nashik.

³Research Scholar, Himachal Pradesh University, Shimla

ABSTRACT

Degradation of land due to waterlogging in sugarcane track of western Maharashtra is a serious problem. Here researchers had understood the problem of the waterlogged areas by preparing an inventory using GIS and GPS techniques. Krishna Canal Command area is lies in Satara and Sangli districts. Total length of canal is 86 km, out of which 21 km length is comes under study area. The command area is divided in 4 segments, out of which, the present study deals with Segment IV. Water table map was prepared using water depth data at 231 well locations. The entire analysis was carried out in ArcGIS software.

GIS – Spatial Analysis tool, point data was rasterised, and surfaces for water table were generated. Risk zonation maps were prepared using the critical limits given by IRD, Pune. Water table surface was intersected with village boundary layers. Risk zonation map of water table suggests that the two villages namely Nagral and Burli situated close to canal are most vulnerable due to high water table. Almost 36 % of the total study area of land covering partially the villages Nagral, Burli, Shirasgaon, Amnapur, Palus, and Yelavi were found under critical water table condition. In segment IV total area of 792 ha in villages Nagral, Burli, Amnapur, Yelavi, and Bhilawadi fall under the P1 category affected most badly by the waterlogging condition. Prioritization of villages based on AWI suggests that out of the total eight villages, five villages namely Amnapur, Burli, Bhilawadi, Nagral and Yelavi are falling under P1 priority category, need immediate attention for remedial measures.

Keywords: Risk Zonation, Priority index, GIS, GPS, Remote Sensing, Non-spatial Data, Overlay Analysis

I. INTRODUCTION

India is home to billion people, 70% of which directly or indirectly associated with agriculture. None the less, agriculture is a back bone of Indian economy. The share of agriculture to the Gross Domestic Product (GDP) is around 28%, also 67% of employment comes from agriculture. Since Independence, India has experienced numerous spans of food shortage, attributed to drought and famines. During the sixties of the present century, scientist came out with an idea of “Green Revolution” with a view to achieve increase in agriculture productivity. Green Revolution is characterized by farm mechanization, provision of water through irrigation, introduction of HIV’s (High Yielding Varieties), use of pesticides and insecticides, etc. But every action has its reaction. Due to over irrigation, many areas now facing the problems of water logging and salinisation.

Irrigation is lifeline for many arid and semi-arid lands throughout the world. Mineral richness of the soils in these regions virtually assures good crops when irrigation is utilized. Irrigation in excess is hazardous because the waterlogged condition shuts off oxygen supply and cripples the plant growth as well as develops

salinity in the soil. Nothing has hurt past civilizations as much as the degradation of their soil and land resources due to water logging and unscientific cultural practices. That way, with spectacular development in irrigation potential, has also come the host of menacing problems of water logging and salinity in irrigation command areas in addition to poor operating efficiency. This is because drainage, the essential component is seldom if ever, given proper attention. According to a recent World Bank study in India, it is estimated that 10 mha of once fertile land has become water logged and 25 Mha are threatened with salinity. Water table is rising at 0.2 - 1.7 m. per year in major surface irrigation systems in India. Drainage along with judicious management of both surface and ground water, which calls in conjunctive use of both surface and groundwater conforming to the tenets of sustainable development, is the need of the hour to save these lands. In India salt affected soils have been estimated to occur 5.6 mha while in Maharashtra around 6 lakh ha are characterized by the saline and waterlogged condition.

In pursuit of improving agricultural production for meeting the growing demand for food, fuel and fodder of ever increasing population,

several irrigation schemes have been launched by both Central and State Government agencies since Independence under various five year plans. Though initially, the schemes proved to be boon to the farmers, gradually water logging condition and subsequent secondary salinisation started developing. Extensive seepage occurring from water flowing canals, distributaries and channels has obstructed the natural drainage. These processes have led to the development of water logging condition and subsequent salinization and alkalization. In view of growing demand for food, wasting productive agricultural lands due to waterlogging and salinization is not affordable.

In the light of such striking facts, there is an urgent need to identify and map such waterlogged and saline areas so that some corrective measures can be taken to reclaim these areas and put them into some productive use. Present study deals with mapping of water logged and salt affected areas in Krishna Canal Command in Karad taluka of Sangli district.

II. ROLE OF GEOGRAPHIC INFORMATION SYSTEM (GIS)

Mapping of the water logged and saline soils is a frantic task, by the traditional methods which require lot of man power and time to identify, classify and map these lands. But on the other hand with advanced techniques like Remote Sensing and GIS this task can be implemented more efficiently by collecting adequate well-distributed sample points from the ground with good location accuracy. The approach to the problem dealing with salt affected and waterlogged land using RS and GIS has proved in many recent studies to be the most efficient. (Rao et al., 1991 and Dwivedi, 1996).

GIS (Geographic Information System) is a powerful set of tools for collecting, storing, retrieving, transforming and displaying spatial data from the real world. It has the ability to assimilate

divergent sources of data both spatial and non-spatial. GIS allows the user to integrate database generated from various sources on single platform and analyze them efficiently in a spatio-temporal domain. GIS provides support in resource management and decision making (Burrough 1986).

Against this background, the present work deals with the cadastral level mapping of waterlogged and saline areas in Krishna Canal Command area of Walwa and Palus taluka of Sangli district of Maharashtra.

III. OBJECTIVES

The primary objective of the study is to map extent and intensity of water logged and saline area in Krishna Canal Command. It would be achieved by

- preparing cadastral level inventory of water logged and saline areas
- prioritizing villages for reclamation

IV. WATER LOGGING

The waterlogged area is defined as “when the water table rises to an extent that soil pores in the root zone of a crop become saturated, resulting in restriction of normal circulation of the air, decline in the level of oxygen and increase in the level of carbon dioxide”. The water table which is considered harmful would depend upon the types of crop, type of soil and quality of water.

Waterlogging is a problem most commonly associated with a rise in the water table. In fact, owing to poor drainage and extensive surface irrigation practices water table sometimes rises beyond a critical limit (normally 1.5 -2.0m from the ground surface) thereby paving way for water logging conditions. The problem of water logging creates multi-facet consequences such as creating humid and unhealthy climate which favours growth of weeds and mosquitoes.

Table 1. Criteria for critical areas of ground water depth

Classification of land	Depth of water table below ground surface
Most Critical	water table below 1.0 m
Critical	water table 1.0 to 2.0 m
Less Critical	water table 2.0 to 3.0 m
Not Critical	water table greater 3.0 m

Source: - IRD Manuals

V. LOCATION OF STUDY AREA

The study area lies between Krishna canal and Krishana River in Satara and Sangli districts of Maharashtra. The total length of the canal is 86 km running from Khodshi dam in Saidapur village to Yelavi village, covers 32 villages in Karad taluka of Satara district and two talukas namely walva and

Palus in Sangli district. The Gross Command area is 15360 hectares. The command area is divided into four different segments. The present study deals with the segment IV lies between Krishna canal and Krishna River in Sangli district. The total length of segment is 21 km. Longitudinal and Latitudinal extent of the study area is from 74° 16”

to 74° 23" East and 17° 03" to 17° 07" North respectively. The Study area includes eight villages

namely Nagral, Shirasgaon, Burli, Palus, Amnapur, Yelavi, Bhilawadi and Dudhondi.

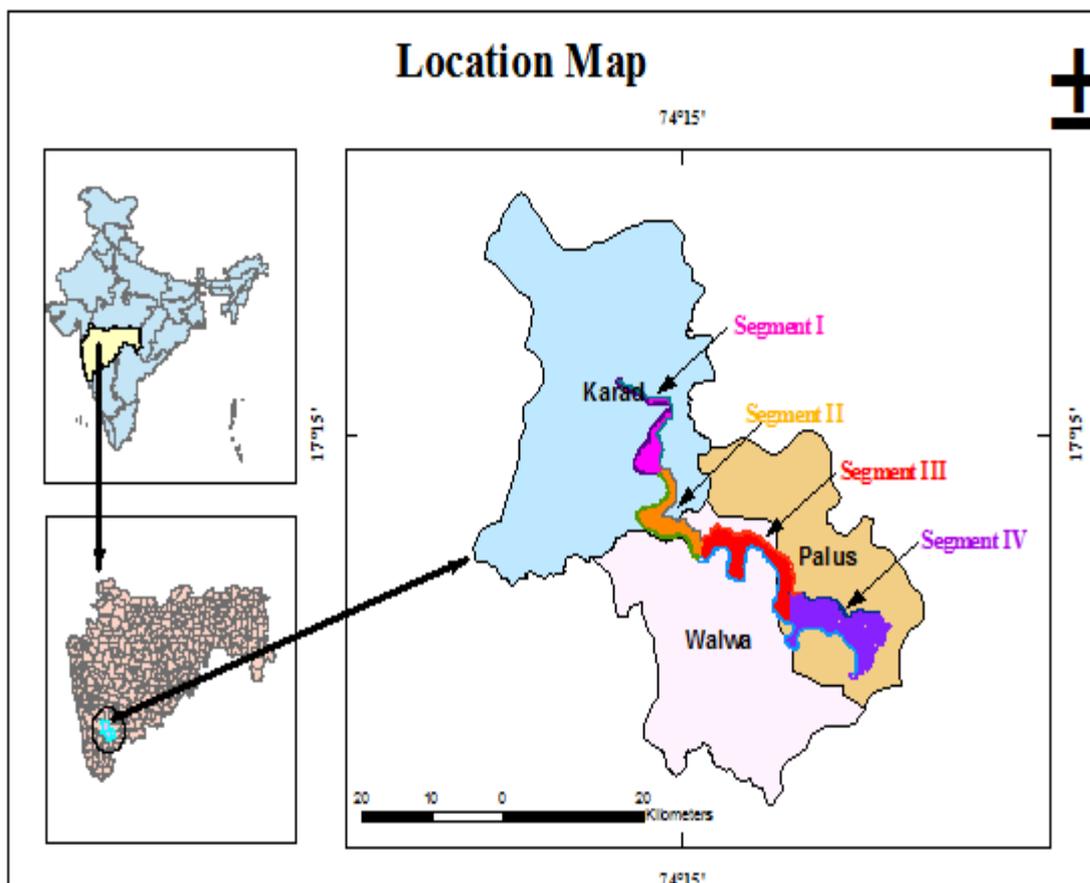


Fig.1- Location of study area

VI. SOURCES OF DATA

The success of any research project highly depends on availability of up-to-date and authentic data. Data is the soul of any research and development activity including planning. For the present study, the data has been gathered from various sources mentioned below.

6.1 a) Aspatial Data:-

I) Primary data:-

- a) Agricultural land use-land cover data and
- b) Crop production data (in tonnage) collected through field survey.

II) Secondary data:-

- a) Water table data (water depth – wells) year 2005-2006 from IRD, Pune division.

6.2 b) Spatial Data:-

- Collection of well distributed Ground Control Points (GCPs) which includes data of latitude, longitude and elevation for a particular point using Global Positioning System (GPS) in the field.
- Collection of GPS coordinates for benchmark (BM) locations

VII. DATA ANALYSIS

7.1 Risk zonation

Following the criteria of IRD given below the surfaces of EC, pH and water table were classified.

Table 2. Water logging criteria for risk zonation

Classification of land	Water table (m)
Most critical	< 1
Critical	1 to 2
Less critical	2 to 3
Not critical	> 3

VIII. RESULT AND DISCUSSION

Land degradation is a composite term; it has no single readily-identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, relief) has changed for the worse. Another definition describes it as, "The aggregate diminution of the productive potential of the land, including its major uses (rain-fed, arable, irrigated, rangeland, forest), its farming systems (e.g. smallholder Subsistence) and its value as an economic resource."

Land degradation due to waterlogging and salinization in sugarcane track of western Maharashtra is a serious problem. Here an attempt has been made to understand the problem of the salt affected and waterlogged areas by preparing an inventory using GIS techniques. The results of analysis are discussed in the following sections.

The ECe and pH surfaces are classified according to critical limits given in methodology section and risk zonation maps for above-mentioned four depths are prepared (Figures 5.7 and 5.8). In segment IV, the pH ranges from 7 to 9 at various depths which indicates slight alkalinity. ECe varies from 0 to 5 ds/m which is far below the critical limit. The figures 5.7 and 5.8 indicate that

almost entire area falls in a no risk to slight risk zone category. Overall there is not much variation observed in the values of pH and ECe, one reason might be the ill-distribution of the sample points.

8.1 Waterlogged Area

Interpolating water depth values for 231 wells in the Segment IV (Fig. No. 2), watertable surface (Fig. No. 3) was generated and classified according to critical limits mentioned in methodology section. Risk zonation map of watertable (Fig. No. 3) indicates that the two villages namely Nagral and Burli situated close to canal are most vulnerable due to high water table. The Coming to next category, almost 2200 hectares (36 % of the total study area) of land covering partially the villages Nagral, Burli, Shirasgaon, Amnapur, Palus, and Yelavi fall under critical water table condition. Almost 60% of the land partially from all villages falls under the less critical category where the problem of water logging is not that much severe compare to earlier two categories. The 264 hectares of land(5% of the total land) from villages Nagral, Burli, Amnapur, Palus and Bhilawadi having water table above 3 meters is considered non critical to waterlogging condition.

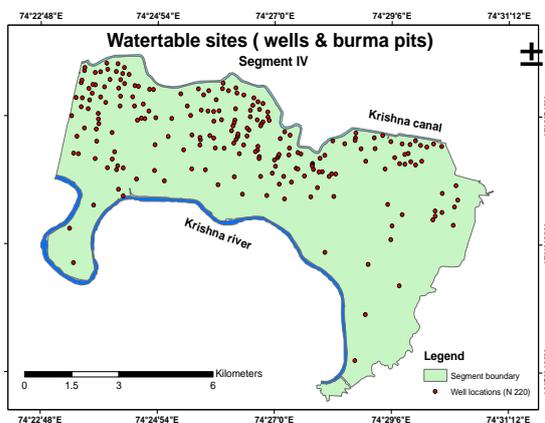


Fig. No. 2

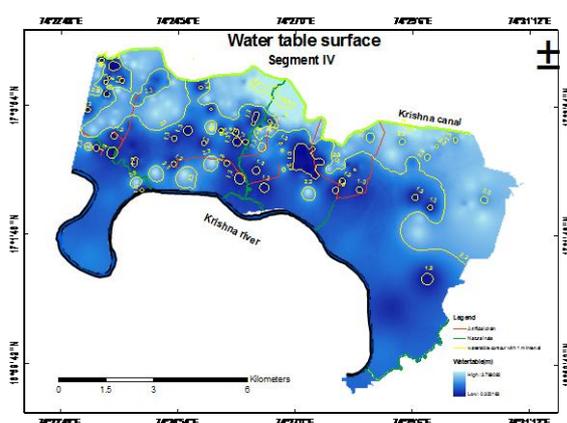


Fig. No. 3

Table 3. Village wise statistics of waterlogged area

Sr. No.	Village Name	Area in(ha)				Total
		Most Critical	Critical	Less Critical	Non Critical	
1	Nagral	7	311	339	2	660.
2	Burli	1	567	610	1	1180
3	Dudhondi			22		22
4	Shirasgaon		202	6		269
5	Amnapur		932	450	.	1383
6	Palus		47	219	151	417
7	Yelavi		68	878		946
8	Bhilawadi			862	108	971
Total		8	2129	3450	264	5852

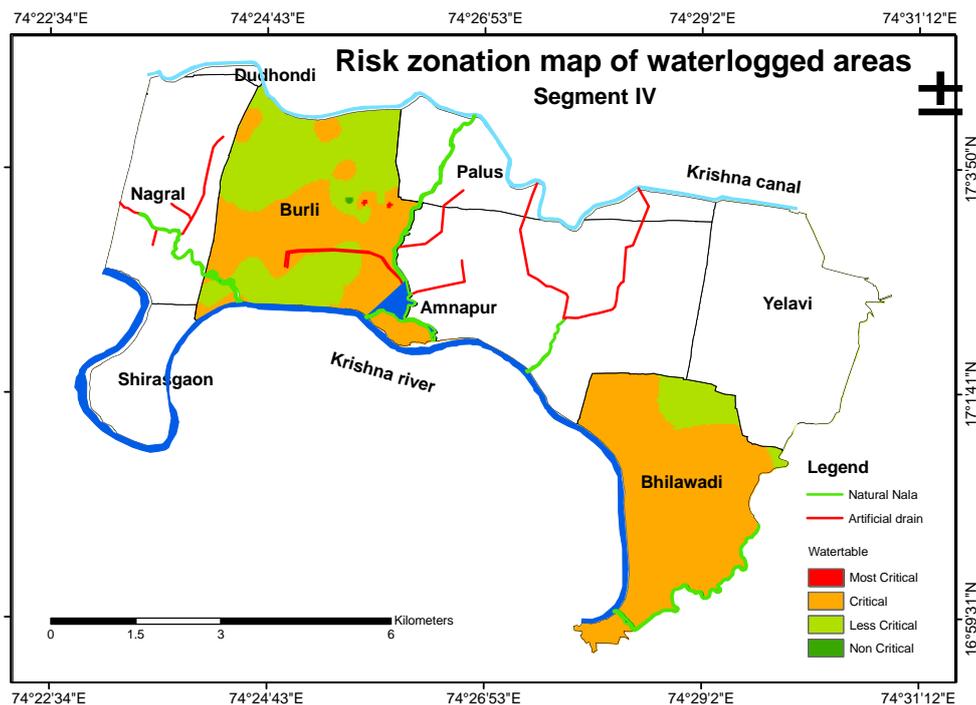


Fig. No. 4

IX. CONCLUSION

Salient features of the study are as below:

- ✓ Risk zonation map of watertable suggests that the two villages namely Nagral and Burli situated close to canal are most vulnerable due to high water table. Almost 2200 hectares (36 % of the total study area) of land covering partially the villages Nagral, Burli, Shirasgaon, Amnapur, Palus, and Yelavi were found under critical water table condition.
- ✓ In segment IV total covering an area of 792 ha in villages Nagral, Burli, Amnapur, Yelavi, and Bhilawadi fall under the P1 category affected most badly by the waterlogging condition. Out of the total area in segment IV, 1539 ha is found to be falling under P4 priority which do not poses severe problem as of now and can be considered later for reclamation.
- ✓ In the segment IV, water table near canal is more than 2.5 m and towards Krishna river side it is swallowing to less than 1.5 m. This indicates that problem of improper drainage is more serious than that of seepage from canal.