CAUSES AND TEMPORAL INVENTARY OF WATER LOGGING AND SALINITY: A CASE STUDY OF ROHTAK DISTRICT, HARYANA

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Abstract: The water logging and saline areas are the major and emotive issues in the east central part of Haryana state. It is a danger problem in canal irrigated and floods affected areas. The present study based on the central-eastern part of the Haryana state. In this study discuss about the changes and main causes of water logging and salinity. The chief causes of water logging in this area are anthropogenic activities of human beings. According to central ground water board Chandigarh, "Rohtak district have a saucer safe and affected by water logging and salinity every year and about 52% part of total study area affected by water logging and about 47% area is salt affected (Central Ground Water Board Chandigarh, 2015)". This problem occurred in the study area from past. In this research paper discuss these problems from 1975 to 2015. During this time period these problems level have increased. The water logged area increased from 663.1 km² in 1975 to 907.4 km² in 2015 and the salinity level also increased from 314.1km² in 1975 to 820.15 km² in 2015. This study based on secondary as well as primary data. In this study used geospatial technology for analyzing and mapping. Landsat TM satellite data are used for analyzing problem. The toposheets and base map are used for mapping. GIS software used for map preparation. Changes in these problems show by maps, charts or diagrams.

Index Terms **- Water Logging, Salinity, Human Health, Problem Changes, Environment and Rainfall.**

I. INTRODUCTION

The Water logging and salinity has been a recurrent phenomenon in Haryana from time immemorial. Many part of the state of Haryana are prone to water logging and salinity. The problems of water logging and salinity prevalent in most irrigated lands have resulted from the excessive use of water for irrigation from inadequate. Water logging and salinity is the major land degradation process which restricts the economic and efficient utilization of soil and land resources in command areas. The natural land physiography, climate and geomorphology agents generate these problems. The application of excess irrigation and recharge from irrigation distribution network causes gradual rise of ground water table and creates water logging and salinity. The water logging and salinity affects crops production, environment and socio-economic status of the people.

Major sources of excess water logging and salinity are floods and rising groundwater table depth. Excessive use of fertilizers in agriculture is also another major cause of salinity. Physical structure (soil, geology, vegetation and climate) of agricultural land is also a cause of water logging and salinity. The poor drainage system is the main cause of this twin problem. The water logging and salinity problem is general issue in canal irrigation areas. The use of saline water for irrigation can direct increase the salinity level in the field. A considerable recharge to the groundwater leads to water logging and salinization in the irrigated areas of semi-arid regions. In the some areas poor quality of groundwater is the main cause of this problem because a high proportion of irrigation water is derived from pumped groundwater. Water logging and salinity is harmful for crop production which cause of economic backwardness of farmers Soil salinity was mainly associated with high groundwater tables. Excessive use of fertilizers and insecticides in agriculture is a main cause in some semi-arid regions for these twin problem. There are some major causes of water logging and salinity e.g. canal irrigation, poor drainage system, excessive use of fertilizers and groundwater quality etc.

II. OBJECTIVE OF THE STUDY

The primary focus of the study is on the factors influencing the water logging and salinity problem in Rohtak district. The physical development trend, the rainfall intensity and the storm water drainage system of Rohtak district is ascertained. Secondly to highlights the temporal change in water logging and salinity. However, the specific objectives of this research are:

- To find out the causes of water logging and salinity in the region
- To investigate the temporal inventory of water logged and salt affected areas using geospatial data.

III. STUDY AREA

The study area lies in the central part of Haryana. The study area having geographical coordinates 28º40'30''N to 29º05'35''N latitude and 76º13'22''E to 76º51'20''E longitude and covers an area of 1745 km² which drained by Diversion Drain No. 8 flowing through the study area. The study area has five blocks namely Rohtak, Maham, Sampla, Kalanaur, and Lakhan Majra. There are 147 villages and 5 towns (Statistical Abstract of Haryana, 2015 – 2016) in the study area (Fig. 1).

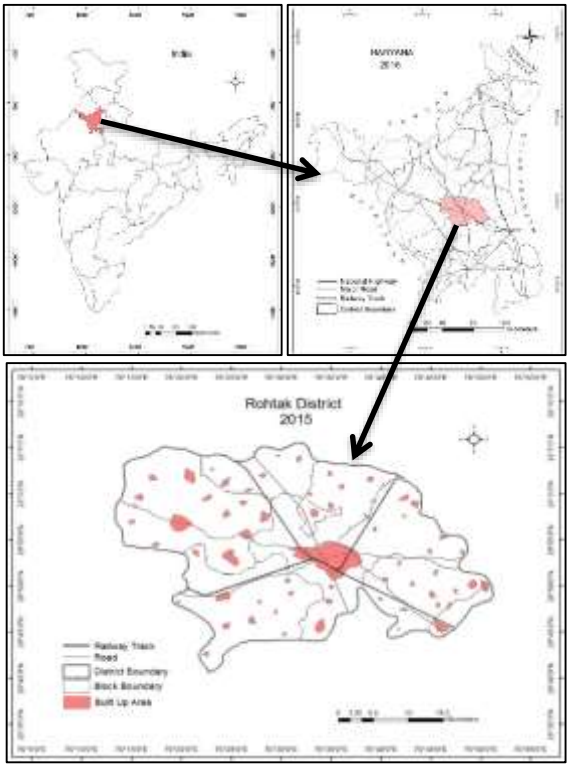

Fig. 1.1

IV. DATA SOURCES AND METHODOLOGY USED

Data source and methodology are central part of any research work which help in scientific description and explanation of reality. In addition to the use of Remote Sensing data, the present study is based on the use of primary as well as secondary data.

- **DATA SOURCES**
  The present study makes the use of mainly secondary sources of information. Data has been collected from different organizations and governmental departments. The nature of the data and the different data bearer Centers are below:
- **SOURCE OF SECONDARY DATA**
  The data for finding out the causes of water logging and salinity is collected from different secondary sources. Satellite data is obtained from the Department of Geography/HARSAC/GLOVIS (USGS) and other freely available sites. The data on Ground Water Table, Soil Types, Cropping Pattern / Crop Production, Irrigation Types, Geology, Physiography, Climate (Temperature and Rainfall), Drainage, Land Use and Population etc is collected from State/Central Government offices and Internet sites.
- **SOURCES OF PRIMARY DATA**
  GPS survey conducted for verification and current year ground water data.

V. METHODOLOGY

In the Present Study the smallest unit of observation is block. The data has been used from 1975 to 2015 for respective fields. Different statistical technique i.e. percentage, average has been used. For supervised classification picking a clustering algorithm to identify the problems and for more clear understanding and showing these problems to prepare few maps. Arc GIS software has been used for map preparation.

VI. FACTORS OF WATER LOGGING AND SALINITY

Longer periods which led to an increase in the seepage of water underground. Furthermore, the use of unscientific methods of irrigation and the tendency of the farmers to over irrigate caused additional percolation. Due to the poor and inadequate drainage system generated conditions of water logging in some parts and after some time water logging generated new problem of salinity. The factors which are responsible for rise of water logging and salinity problem areas are under:

- **TOPOGRAPHY OF THE STUDY AREA**
  Topography of the study area is the main cause of water logging and salinity in present time in the study area. According to the Water Board Commission Chandigarh (2014), about 65 per cent blamed the topographic condition of Rohtak district is responsible for water logging. The surface contours of this area shows that with drain no. 8 meets the Yamuna at 215 meters.
  There is hardly a fall of 11 metres over a distance of more than 75kms. The outcome of this is that there has been back flow into drains and large areas remain flooding during and after the monsoon and consequently this halts the process of Rabi sowing. This process has been repeated over many years, led to rise in water table and the salts that were present in the sub – soil layers gives rise to secondary salinization.

- **GEOLOGY, PHYSIOGRAPHY AND HYDROGEOLOGY**

The study area (Rohtak district) is occupied by Indo-Gangetic alluvium. There is no surface features worth to mention. Physiographically the area has flat terrain. The slopes in the study area are towards northeast to southwest with the average gradient of 0.19 m/km. The general elevation of the study area varies between 215 m to 222 m above mean sea level. The soils of the study area are fine to medium textured. According to soil and hydrological department Rohtak; the sandy loam found in Rohtak, Sampla, and Lakhan Majra blocks whereas loamy sand with occasional clay loam found in Kalanaur and Meham Blocks. In the study area soil have High potassium, medium phosphorus and low nitrogen. The most part of the study area is dominated by saline soils. In saline soils the physical properties of the soil of the study area are very poor because the excess sodium on the exchange complex imparts poor physical properties to the soil mass. As a result of this, the surface water retention capacity and the infiltration rates of the soil are very low such that mostly rainfall which received by these soils, goes as run – off. The saline soils generally have basic infiltration rates of water are less than 1 cm/day besides this the initial infiltration rate is low at high exchangeable sodium percentage of saline soil. Saline soil affected the agricultural sector and it is the cause of serious problem which generated by surface drainage.

In the south – western part of the study area (Rohtak district), the ground water aquifers have relatively poor hydraulic properties. The introduction of canal irrigation, less exploitation of ground water and poor natural sub – surface drainage conditions have resulted in water logging and soil salinity problems. The high water table gives rise to both surface and sub –surface drainage problems and also limits the recharge of fresh quality rain water. The high evaporation rate and saline water table close to the soil surface cause soil evaporation more than the sub – surface flow resulting in the development of high salinity. Thus the drainage problem is also associated with the occurrence of salt affected soils both of saline in nature.

- **SURFACE LITHOLOGY**

The sub-surface Lithology of the Yamuna - Ghaggar plain indicates that the thickness of the alluvium decreases from east to western and north to south from boundary where it is underlain by pre-Cambrian rocks. The distribution of alluvial sediment soils indicates that percentage of sand is more than clay and silt in fresh water regions in north – eastern part of the Rohtak district. The occurrence of marginal ground water in the clay predominant environment of south western part of district gives rise to probability of close relationship between Lithology and water logging - salinity. High density sub – alluvium ridge that lies buried along Rohtak – Hisar – Delhi axis obstructed the flow from Shivalik to the west – south and might have been responsible for creating water logging and salinity.

- **CLIMATE, RAINFALL AND TEMPERATURE**

The climate of the study area (Rohtak district) can be classified as sub-tropical monsoon, dry & mild winter, sub-humid and hot summer which is mainly dry with cold winter and very hot summer except during monsoon season when moist air of oceanic origin penetrates into the district. Rainfall is a major cause of water logging and salinity in the study area. Temperature is also the one of the main cause of salinity in the study area. According to the central soil salinity control board Chandigarh, about 15% salinity causes by temperature. The transpiration of water increases the salinity level every year.

VII. SOME OTHER CAUSES OF WATER LOGGING AND SALINITY

- **CAUSES OF WATER LOGGING**
  - Obstruction of natural drainage
  - Impermeable clay layer below the soil
  - Obliteration of natural drainage
  - Inadequate capacity for arterial drainage
  - Construction of a water reservoir
  - Natural obstruction to the flow of ground water

- **CAUSES OF SALINITY**
  - The factors of salinity are almost same as water logging factors.
  - In agricultural soil has certain mineral salt it like NaCl, Na_2CO_3, Na_2SO_4 etc. which are responsible for salinity.
  - The more uses of fertilizers and insecticides in agricultural are the main cause of salinity.

VIII. TEMPORAL INVENTARY OF WATER LOGGING AND SALINITY

Water logging and salinity are the major issue in the study area. Almost every village of study area is affected by these twin problems. The level of water logging and salinity increased from 1975 to 2015 in the study area. Many times the study area is highly affected by these twin problems. The below discussion explain the temporal inventory of water logging and salinity.

- **SPATIAL EXTENT OF WATER LOGGING AND SALINITY IN 1975**

There are five block (Rohtak, Mehem, Sampla, Lakhan Majra and Kalanaur), 143villagesand 5 towns (Statistical Abstract of Haryana, 2015 - 2016) in the study area. All the villages are affected by water logging and salinity. Out of total 1745 km² study area, 663.1 km² areas falls under water logging and 314.1 km² areas falls under salinity. In 1975 about 34.9 km² area was severely water logged,104.7 km² area severely salinity affected, 261.75 km² area moderate water logged, 157.05 km² area moderate salinity affected, 366.45 km² area slightly water logged and 52.35 km² area slightly salinity affected. In the Rohtak block Ghillor, Jassia, Kahni, Rithal, Kiloi, Bhagwatipur, Titoli, Sunderpur and Shimli are highly affected by water logging. Katwara, Sanghi, Khadwali, Jindran, Basantpur, Dhamar, Makrauli Kalan and Ladhout are highlyaffected by salinity. In Sampla block Naya Bans, Bhainsru Kalan, Pakasma and Atail are highly affected by water logging and Baliyana and Bhainsru Khurd are affected by salinity. In Meham block Farmana, Kharak, Nindana, Shekhpur Titri, Girawar and Nidana are highly affected by water logging. Meham, Sisar Khas, FarmanaKhas and Seeman are highly affected by salinity. In Lakhan Majra block Chandi, Indergarh and Kharainti are highly affected by water logging. Nandal and Chandi are highly affected by salinity. In the Kalanaur block Gudhan, Anwal , Sampal,Basana, Bhali and Garhiare highly affected by water logging and Kalanaur, Nigana, Sangahera, Pilanaand Masudpur are highly affected by salinity.

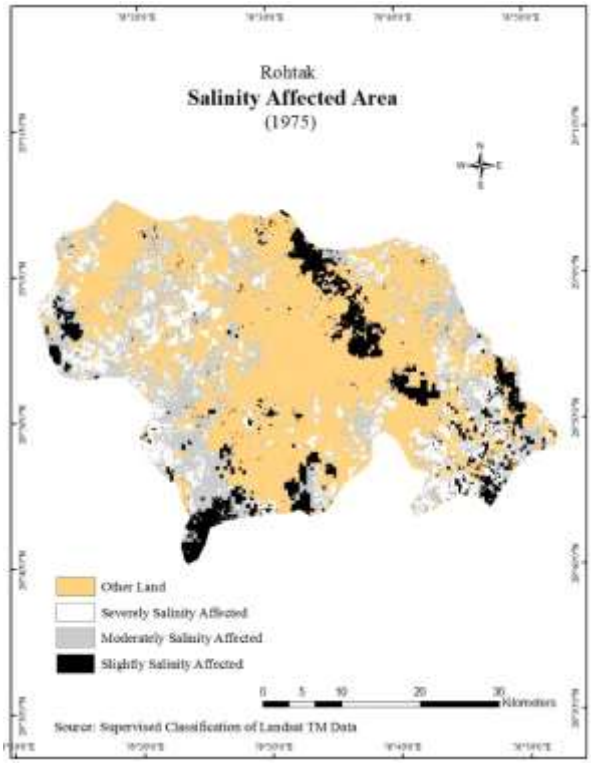

Fig. 2. Water Logged Area in 1975.

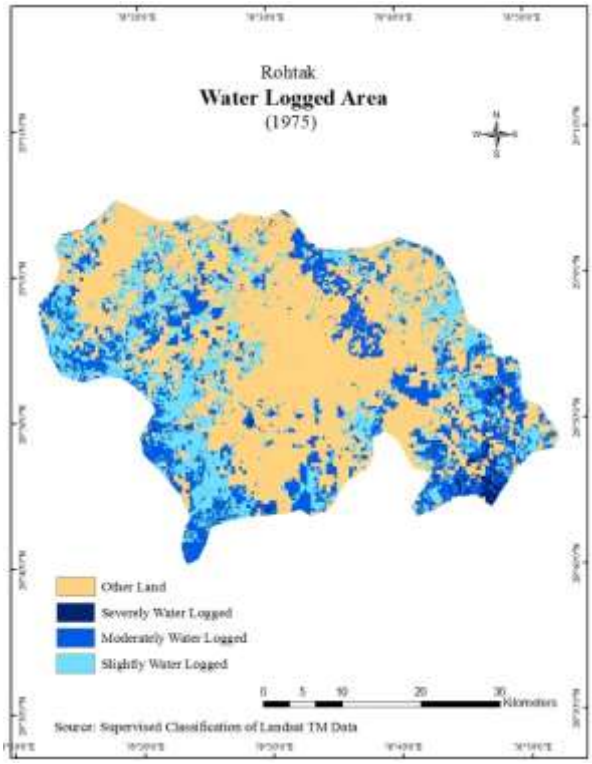

Fig. 3. Salinity Affected Area in 1975.

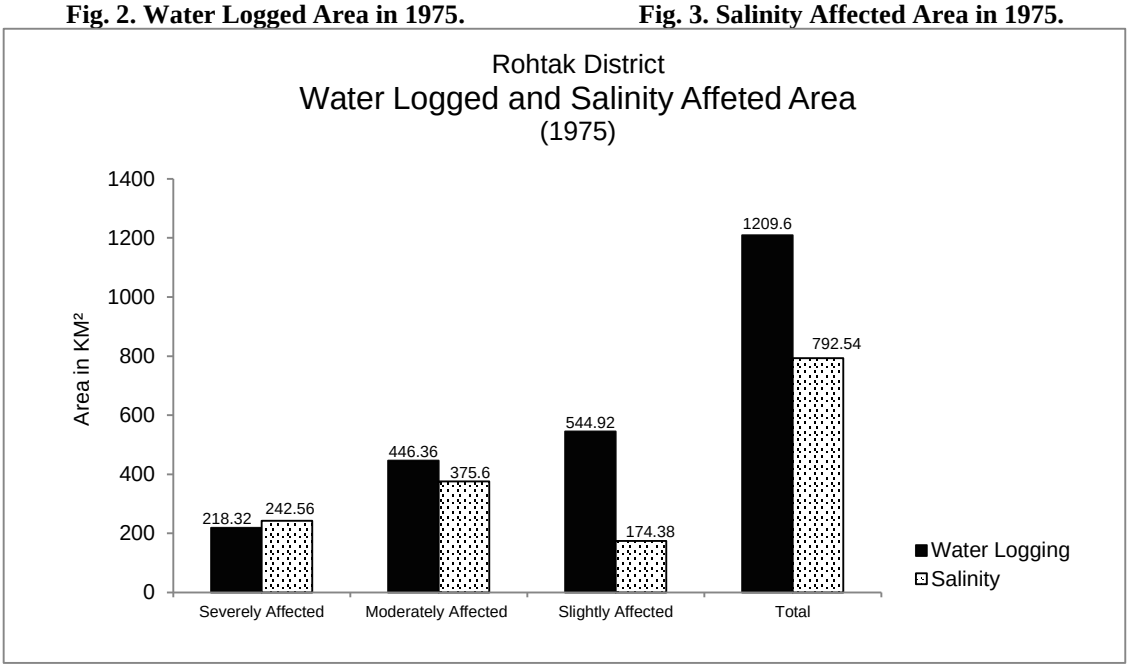

Fig. 4. Water Logging and Salinity Affected Area in 1975.

- **SPATIAL EXTENT OF WATER LOGGING AND SALINITY IN 2015**

Water logging and salinity were the major issue in study area. In 2015 this twin problem were seen in many villages of study area. Some villages of the Rohtak district were highly affected by this twin problem in 2015. About 55% part of the study area were affected by these twin problems. More than 50% area of total study area was affected by water logging problem and about 47% area was affected by salinity problem. In 2015 about 139.6 km² area was severely affected by water logging,401.35 km² area was severely salinity affected, 331.55 km² area was moderate water logged, 261.75 km² area moderate salinity affected, 436.25 km² area was slightly water logged and 157.05 km² area was slightly salinity affected Meham and Lakhan Majra block highly affected by water logging problem. Kalanaur, Rohtak and Meham block highly affected by salinity problem. Some villages of lakhan majra, and Sampla blocks were also affected by salinity problem in 2015. Sangahera, Pilana, katesra, Kabulpur, Ritauli, Gudhan, nigana, sudana, garhi and baland villages of kalanaur block highly affected by salinity problem in 2015. Bhaini Bhairon, Sisar khas, Bhaini Maharajpur, meham, Farmana and bedwa villages of Meham block were highly affected by salinity problem in 2015. Hasangarh, Samchana, Gijji, Bhainsru Khurd and sampla in Sampla block and nandal in lakhan majra block also affected by salinity problem in 2015.

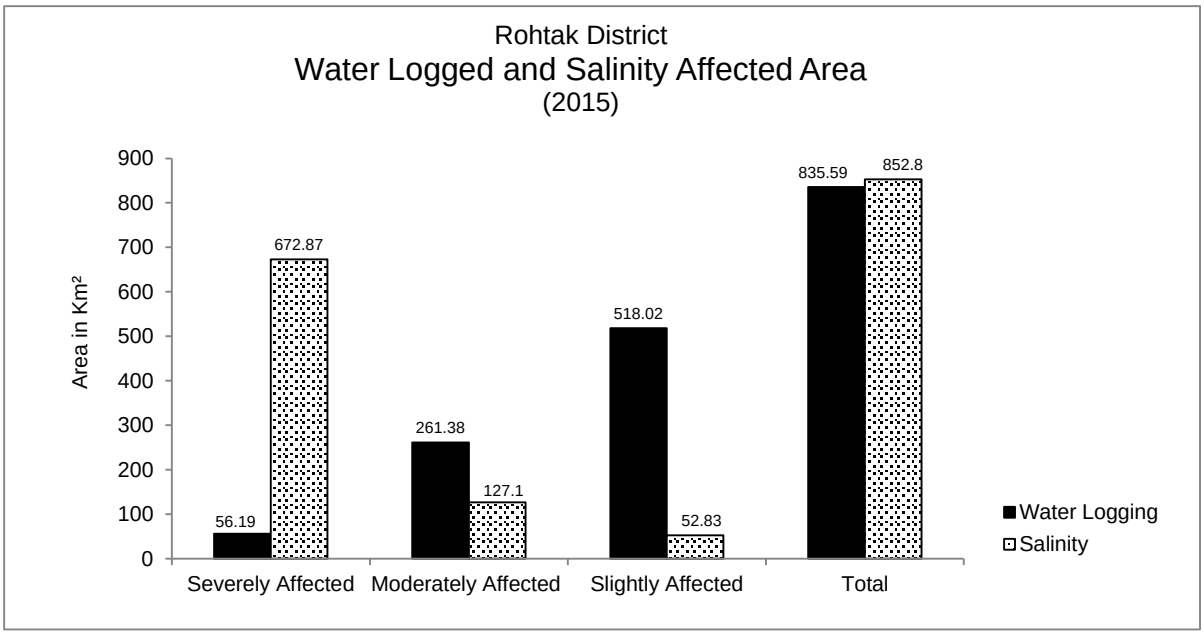

Fig. 5. Water Logging and Salinity Affected Area in 2015.

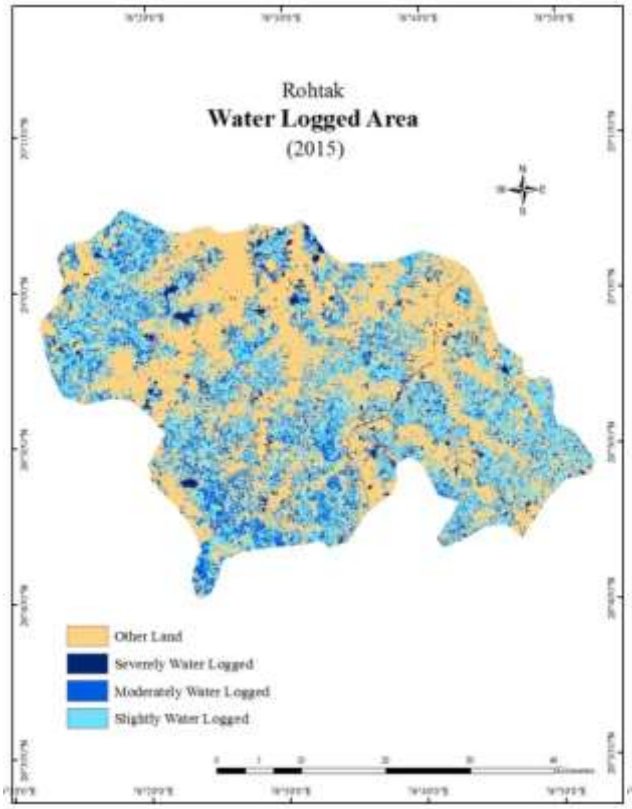

Fig 6. Water Logged Area in 2010

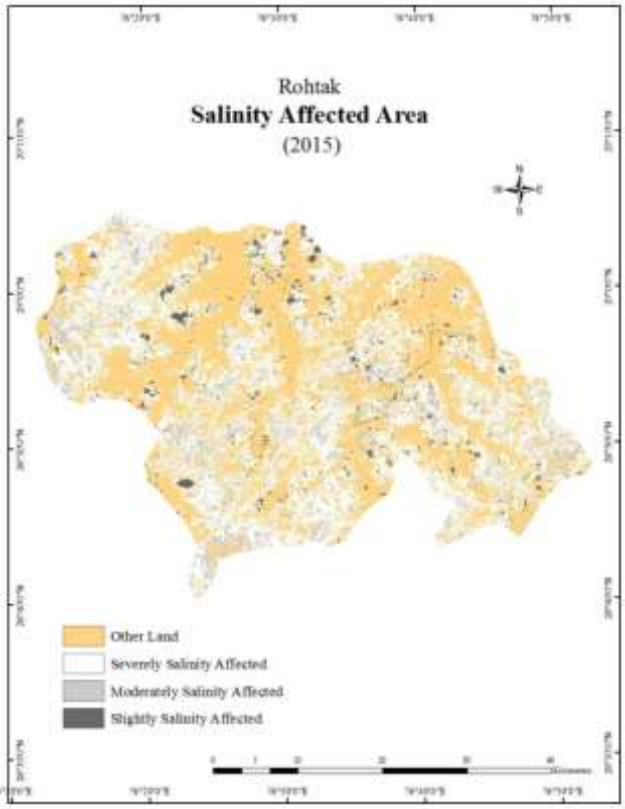

Fig 7. Water Logged Area in 2010

IX. CHANGES IN WATER LOGGING AND SALINITY DURING 1975 TO 2015

Water logging and salinity is a main environmental problem in the study area. It has many changes from 1975 to 2015. During this time period many floods and many environmental problems occurred. Plants and others infrastructure also affected by this twin problem this was not new in these area this occur in those areas from time immemorial but after the 1975 this problem highlighted by many research study and after that the work started in this field. Some villages of the study area were fully destroyed by this twin problem during this period. Many changes in water logging and salinity were faced by the study area during this time period (Table 1, Fig. 8). During this time period the severely water logged area decreased but severely salinity affected area increased. Moderately water logged area decreased and moderate salinity affected area also decreased. Slightly water logged area decresed and slightly salinity affected area also decreased. The total water logged and salinity affected area decreased during this time period. Government also due their attention to the farmers and local people of this area. At large scale this problem also control by government in high affected areas. The farmers awareness also the affected the level of this problem.

Table 1

Area under Water Logging and Salinity (1975 – 2015)

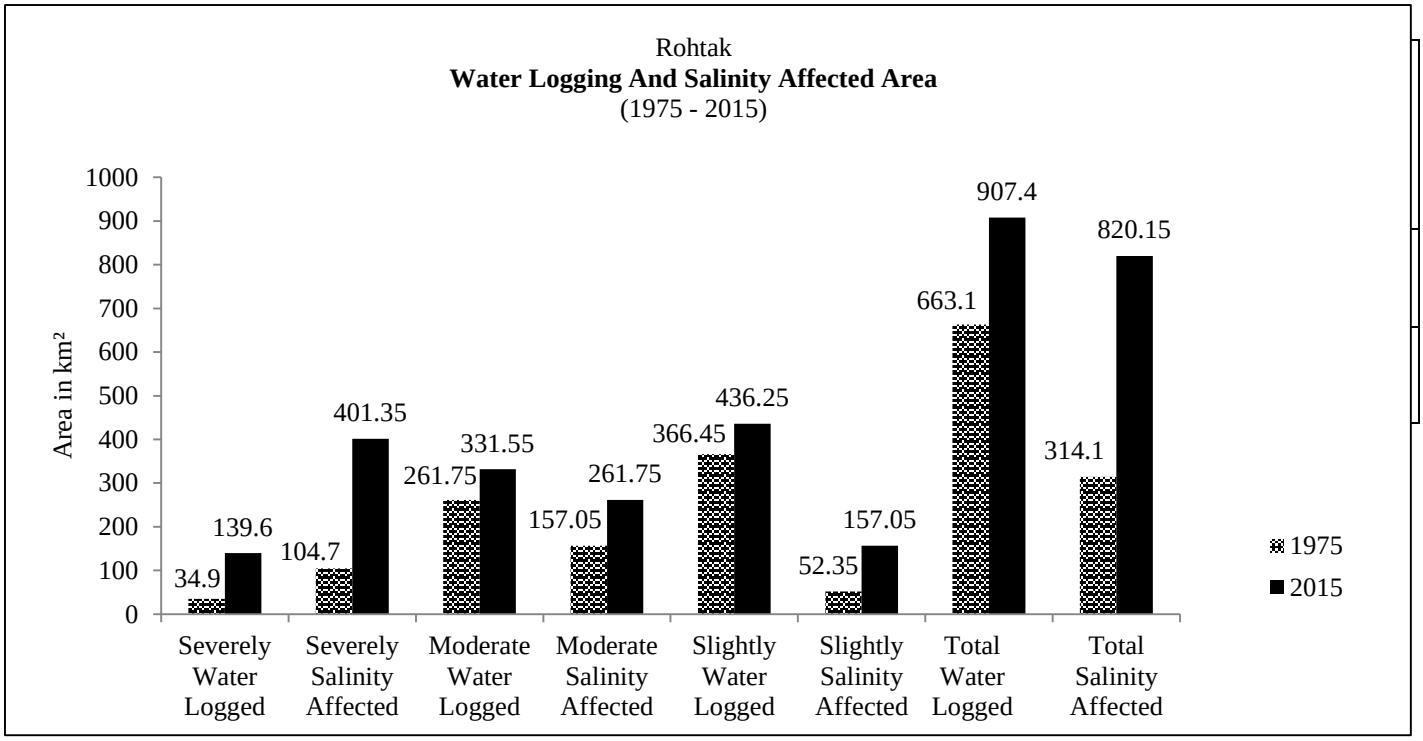

Fig. 8. Area under Water Logging and Salinity (1975 – 2015)

X. CONCLUSION

It is evident from the study that the water logging and salinity is a major issue in Rohtak district. The study reveals that the level of water logging and salinity increased over last four decades. The physiography and irrigation system of the study area are the main causes of water logging in the study area. It has been found out that these twin problems occurrence in the study area by the interaction of a large numbers of factors. Every years this account increase about 0.3% to 1.5%. Many natural and artificial factors causes of water logging and salinity in the study area. In 1975 the total water logged area of the region increased about 244.3 km² and the salinity area also increased about 506.05 km². This twin problem affected the many parts of the study area and highly affected the agricultural land in the region. Hence, once the problems of water logging and salinity become acute, change in any (one or two) factors alone cannot immediately reverse the water logging and salinity trend. The major barrier which come in way of reduction of these twin problems are that the farmers do not aware these severe problems.

XI. REFERENCES

- Annual Administrative Report, 2000-2014, Irrigation Department, Haryana, Government of Haryana.
- Ali M. 2008. Degradation level of water bodies by salinity and others environmental issues, International Journal of Earth Sciences and technology, June 2008, Vol. III: pp 23-31.
- Ground Water Information Booklet, Rohtak District, Haryana (2014).
- Singh S.2013. Water Logging And Its Effect On Cropping Pattern And Crop Productivity In South-West Punjab : A Case Study Of Muktsar District, Journal of Economic & Social Development, Vol - IX, No. 1, 2013.
- Singh, A., Panda, S. N., Flugel, W.A. and Krause, P. 2012. Water logging and farmland salinisation: causes and remedial measures in an irrigated semi-arid region of India, International Journal of Environment and Technology (2012), Vol. 2, Issue IV, pp.1-3.
- Podmore C.2009. Dryland salinity – causes and impacts, Prime Facts for profitable, adaptive and sustainable primary industries, October 2009.
- Report of The High Level Expert Group on Water Logging in Punjab, Government of India Planning Commission, January, 2013.
- http://abstractharyana.gov.in/Data/Haryana
- http://journals.lww.com/soilsci/Abstract/2000/01000/Soil_Management_in_the_Developing_C untries.8.aspx
- http://www.sciencedirect.com/science/article/pii/S0378377402000586
- http://journals.lww.com/soilsci/Abstract/2000/01000/Soil_Management_in_the_Developing_Countries.8.aspx
- http://www.sciencedirect.com/science/article/pii/S0378377402000586
- http://www.bioone.org/doi/abs/10.1579/0044-7447-33.1.52
- http://dx.doi.org/10.1016/S0378-3774(02)00058-6, How to Cite or Link Using DOI