RS & GIS Applications for Choe Infested Kandi Area in Dhar Kalan, and Sujanpur Blocks of Pathankot

[1]Rajesh Jolly, [2]Dr. Ripudaman Singh
[1]Assistant Professor, [2]Associate Professor
[1]Department of Geography, DAV College, Jalandhar
[2]Department of Geography, School of Arts and Languages , Lovely Professional University, Punjab

Abstract- A case study has been conducted at block level to identify the village severity level for the choe (seasonal stream) infested areas in the Kandi region of Pathankot district, Punjab. For the identification of the severity level, Remote Sensing and GIS have been utilized to achieve the desired results. The drainage maps were prepared from the Bhuvan official website of satellite data of IRS Resourcesat 1, LISS III. Spatial layer such as the drainage layer consisting of seasonal streams (choes), Canals, Ponds/Reservoirs, etc. were created in GIS Software for analyzing the severity of the problem with the spread of the choe bed from 50 to 500 meter buffers. The villages were ranked according to the severity of the problems and areas were calculated for the 50 to 500 meter zone of the choe infested. During the study, it has been noticed that major cities and district headquarter were identified at the high-risk zone for flooding in the near future. In comparisons to three blocks of Kandi Region (Dharkalan, Pathankot, and Sujanpur) Dharkalan block has maximum coverage of choe infested areas with a more severe number of villages affected by seasonal streams.

Index Terms—Kandi Region (Foot Hill of Shiwaliks of Punjab) Choe Infested (Seasonal Stream). IRS (Indian Remote Sensing Satellite), GIS (Geographical Information System), RS (Remote Sensing), DCH (District Census Handbook)

I. INTRODUCTION

Pathankot is a newly carved district of Punjab with Latitudes 32° 5′ 12″ N (southernmost point) to 32° 30′ 47″ N (northernmost point) and Longitudes 75° 31′ 45″ E (westernmost point) to 75° 56′ 05″ E (easternmost point), headquartered at Pathankot City. The government declared it as a new district in 2011 (July). Earlier, Pathankot was a Tehsil of Gurdaspur District, and a meeting point of three north Indian states of Punjab, Himachal Pradesh, and Jammu & Kashmir. Its ideal location makes Pathankot a tourist junction for these neighboring states (Singh and Khanudi, 2011). Jammu & Kashmir is connected to the rest of India through Pathankot, which is strategically also important. District of Pathankot spread across 929 sq. km. area of the Punjab state, which constitutes its 1.84 percent area only. In census 2011, it comprised 6,26,154 persons, which was 2.26 percent population of the state (Govt. of India, 2011). The district has 462 villages with hilly, Piedmont, foothill and plain physiography. District of Pathankot comprises mainly of three blocks of Dharkalan, Pathankot, and Sujanpur. The landscape of the Pathankot district has varied topography comprising the hilly tract, undulating plain, the flood plains of Ravi and Beas rivers and the upland plains (Singh and Khanduri 2011). The hilly tract covering the north-eastern parts of Pathankot and Dhar tehsils have typical land topography, ranging in elevation from about 381 to 930 meters above sea level. From north to south the track consists of three small ranges running in the northwest to southeast direction (Singh et. al., 2011).

II. STUDY AREA

Pathankot district has a sub-mountainous undulating region located in the northern part of the state. Physiographically speaking, this region has hills and piedmont plains, Alluvial fans and table land plateau (Singh and Khanduri, 2011). The boundary of the district exactly matches with the administrative boundaries of block and village boundaries. Villages of these blocks fall under Kandi and non-Kandi areas. This region faces a number of problems which have resulted in the backwardness of the entire region. Besides a lot of government efforts and subsidies programs, it has not been able to uplift the development of the region.

Pathankot District has an average annual rainfall ranging from 800 to 1500 mm, which receives higher precipitation in monsoon season (July-September). In winter season (November to March) rainfall is lesser in the entire district region for about 170 mm. In extreme winters, the minimum temperature of December and January months may be close to freezing point and the maximum during May-June reaches to about 45 degrees (Govt. of India, 2011).

The Shiwaliks of the Pathankot district is marked by the presence of extremely dissected zone. The easy erodability of Shiwalik rocks, their abrupt rise from the foreland resulted in rapid and active erosion in the study area. The region is presently facing the number of problems, viz., it does not possess sufficient vegetation cover at many places; forest fires, degradation, and human encroachment are common in forested areas (Sharma et.al., 2004). During the rainy season, hills are exposed to heavy soil erosion and this cause degradation of precious agricultural land in the flood plain.

Beas and Ravi are the two main rivers flowing in the Majha region of Punjab and also in the Pathankot district. Upper Bari Doab Canal system is the main source of irrigation in Majha and most parts of Pathankot. The main tributary of river Beas, Chakki Khad is a major stream rising in the Dalhousie hills and also makes the boundary with Kangra district. Chakki Khad

joins river Beas near Mirthal in Pathankot. River Ravi is the chief river which makes the boundary between Punjab and Jammu & Kashmir and also with Pakistan. Many tributaries from Jammu hills like Ujh, Jalalia, and Masto, joins Ravi river, which traverses through the district. During the rainy season, these rivers make havoc in the region. (Singh et.al.,2011)

Table no. 1 Area under drainage category in Pathankot district

Sr. No.	Category	Area (Sq. Km.)	(In Percentage)
1	River Beas	2.2	4.9
2	Sandy area (River Sand)	10.5	23.2
3	Water channel area	14.2	31.3
4	Pond	0.06	0.1
5	Reservoirs	14.5	32.0
6	Waterlogged	1.12	2.5
7	Canal (UBDC)	2.77	6.1
	Total Area (Sq. Km)	**45.35**	**100**

Source: IRS Resourcesat 1 LISS III, Jan & Feb. 2014, 2016 from Bhuvan Offical Site.

Ranjit Sagar dam having a power generation capacity of 600 MW on river Ravi is the main source of power in the region (Sharma. G.N, et.al. 2007). Shahpur Kandi and Madhopur headwork are other hydro projects in the district. Table 1 depicts the areal coverage of various drainage categories of Pathankot. Reservoirs, water channel and sandy areas comprise more than 85 percent coverage in the district.

III. METHODOLOGICAL PLAN

For accomplishing the task of identifying the choe infested areas in Dhar Kalan and Sujanpur blocks of Pathankot district, following steps have been taken.

Step1. Preparation of Spatial Database (Drainage Layer of Kandi Region of Punjab)

The spatial database of the study region has been prepared from the free online source of satellite data i.e Bhuvan official site. The satellite data of IRS Resourcesat 1; LISS III has been utilized to prepare a drainage map of the study region. The spatial layer with different category consisting of Seasonal Stream, canal, pond, reservoir, etc. database has been generated in the ARC GIS 10.1 environment.

Step. 2 Preparation of spatial database (Village Map of Pathankot District)

After successful creation of the digital layers of drainage of the study region, the second important layer is the base layer that is village boundary of the Kandi region. The village boundary in digital format has been purchased from a survey of India, Dehradun. The village boundary was further edited and topologically rectified in the ARC GIS 10.1 GIS software. The village boundary collaborated at block and district level.

The creation of attribute data has been done in Microsoft Access and Excel Database which could be easily imported to any environment for further analysis, e.g., the identification of Kandi and non Kandi villages in the Pathankot district would have been quite helpful from the Punjab Planning department official site, where the list of Kandi villages available.

Step. 3 Linking of Spatial and Non-Spatial database in the GIS Environment

The Spatial and non-spatial database created in a different environment then inter-linked in the GIS environment for further spatial analysis of the database and mapping of the different layers of the region.

Step4. Identification of Gaps and Severity of the Problem in the Region

Firstly, on the basis of the drainage network, the villages were identified under the catchment area of the seasonal stream Choes (Arc GIS 10.1). Secondly, these identified villages were further categorized under the intensity of the problem by giving multiple buffering to layers. Thirdly, the villages close to the proximity of the buffered layer were given high severity index of the problem and the villages far away from the buffer were give the low intensity of the problem.

Step 5. Identification of Planning Priorities areas in the region

On the basis of the Severity of the problems, the villages are classified on the basis of the planning priority regimes, for example, the villages with high severity index will come under the topmost planning priorities in the region (Jolly, 2003).

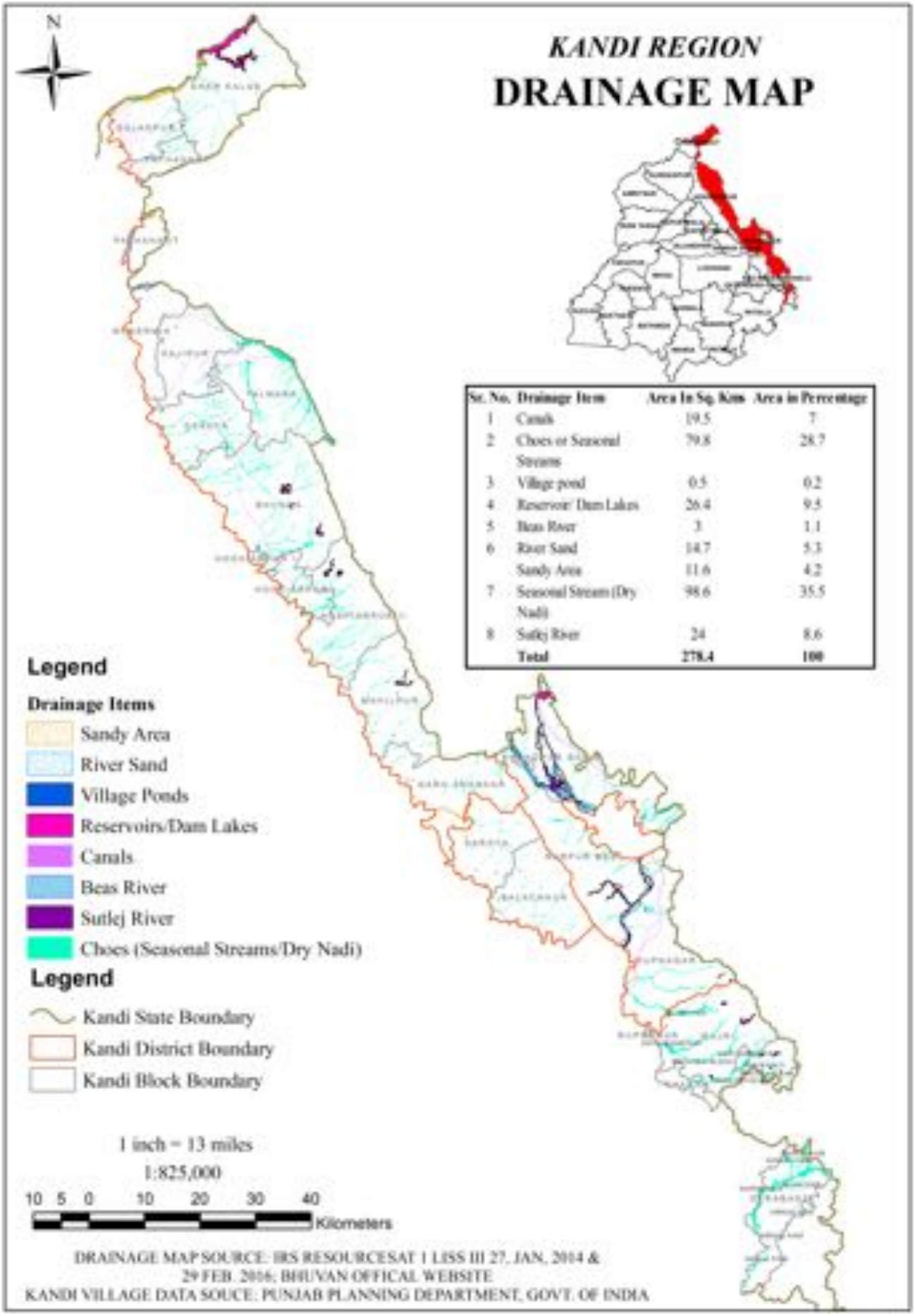
KANDI REGION
DRAINAGE MAP
N
Sr. No. Drainage Item Area In Sq. Kms Area in Percentage
1 Canals 19.5 7
2 Choes or Seasonal Streams 79.8 28.7
3 Village pond 0.5 0.2
4 Reservoir/ Dam Lakes 26.4 9.5
5 Beas River 3 1.1
6 River Sand 14.7 5.3
Sandy Area 11.6 4.2
7 Seasonal Stream (Dry Nadi) 98.6 35.5
8 Sutlej River 24 8.6
Total 278.4 100
Legend
Drainage Items
Sandy Area
River Sand
Village Ponds
Reservoirs/Dam Lakes
Canals
Beas River
Sutlej River
Choes (Seasonal Streams/Dry Nadi)
Legend
Kandi State Boundary
Kandi District Boundary
Kandi Block Boundary
1 inch = 13 miles
1:825,000
10 5 0 10 20 30 40
Kilometers
DRAINAGE MAP SOURCE: IRS RESOURCESAT 1 LISS III 27, JAN, 2014 &
29 FEB, 2016; BHUVAN OFFICAL WEBSITE
KANDI VILLAGE DATA SOUCE: PUNJAB PLANNING DEPARTMENT, GOVT. OF INDIA

Figure 1

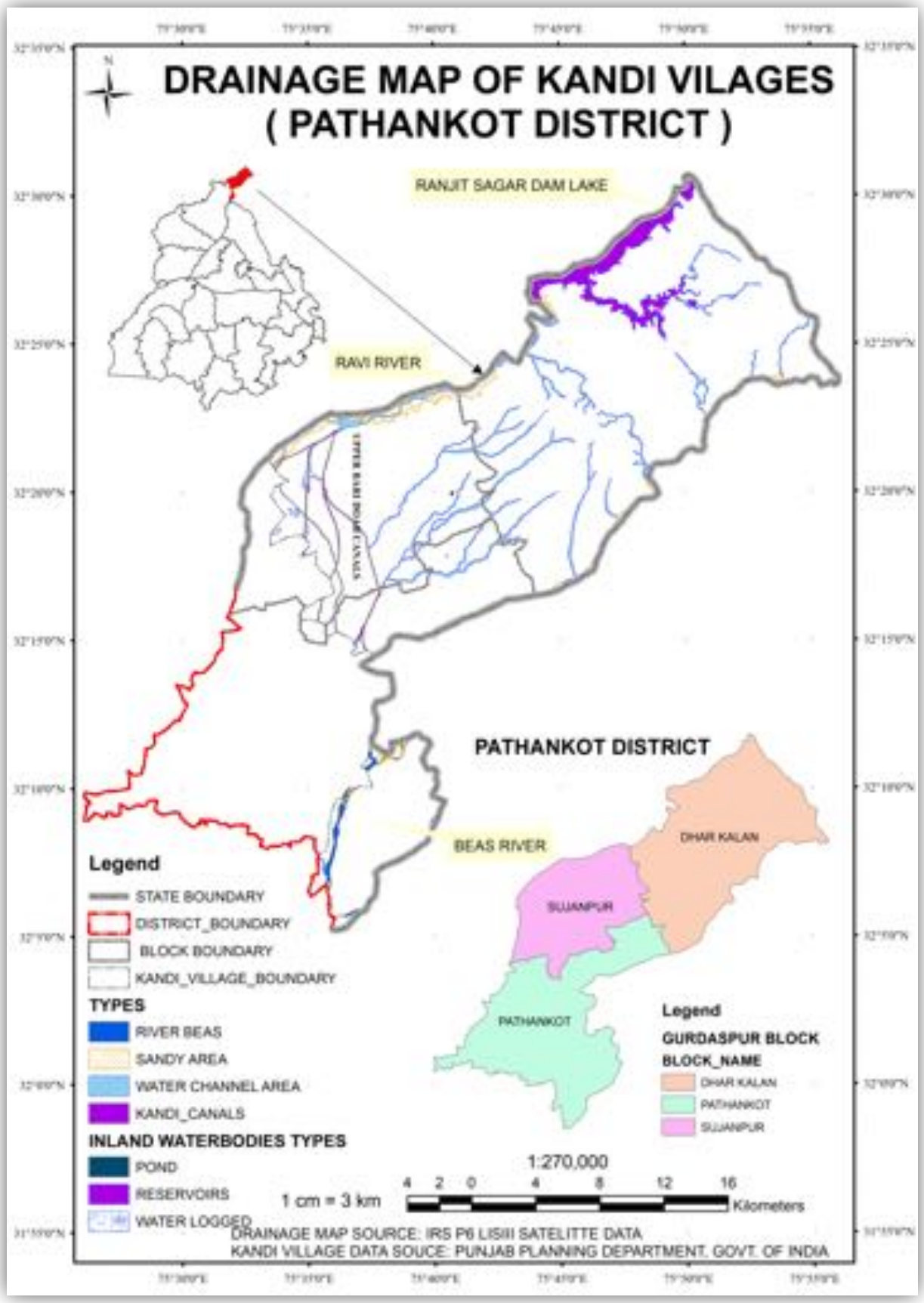
DRAINAGE MAP OF KANDI VILAGES
(PATHANKOT DISTRICT)
RANJIT SAGAR DAM LAKE
RAVI RIVER
BEAS RIVER
PATHANKOT DISTRICT
DHAR KALAN
SUJANPUR
PATHANKOT
Legend
STATE BOUNDARY
DISTRICT_BOUNDARY
BLOCK BOUNDARY
KANDI_VILLAGE_BOUNDARY
TYPES
RIVER BEAS
SANDY AREA
WATER CHANNEL AREA
KANDI_CANALS
INLAND WATERBODIES TYPES
POND
RESERVOIRS
WATER LOGGED
Legend
GURDASPUR BLOCK
BLOCK_NAME
DHAR KALAN
PATHANKOT
SUJANPUR
1:270,000
1 cm = 3 km
4 2 0 4 8 12 16
Kilometers
DRAINAGE MAP SOURCE: IRS P6 LISIII SATELITTE DATA
KANDI VILLAGE DATA SOUCE: PUNJAB PLANNING DEPARTMENT, GOVT. OF INDIA

Figure 2

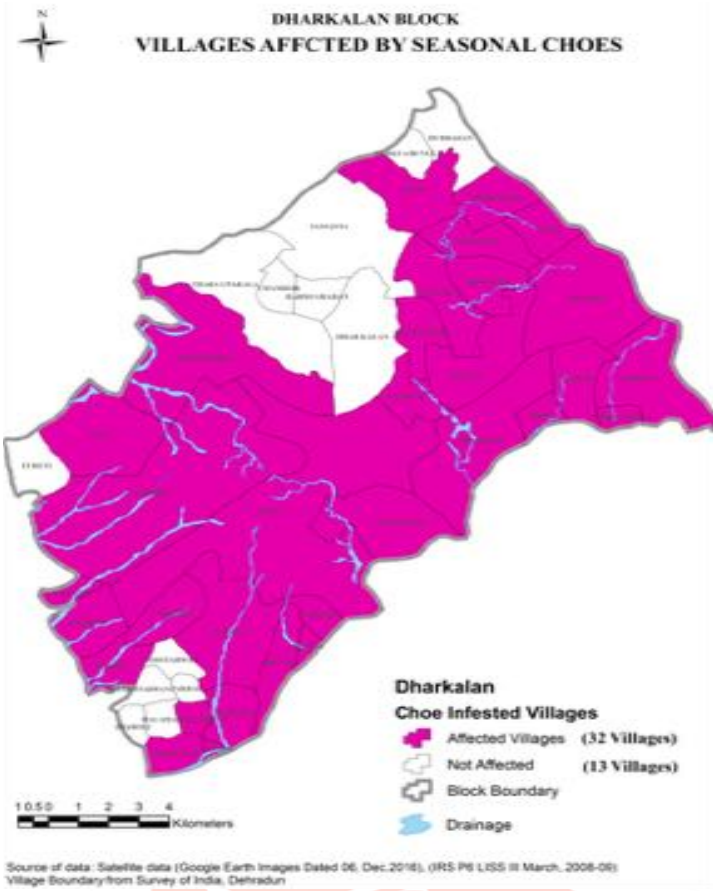

Figure 3

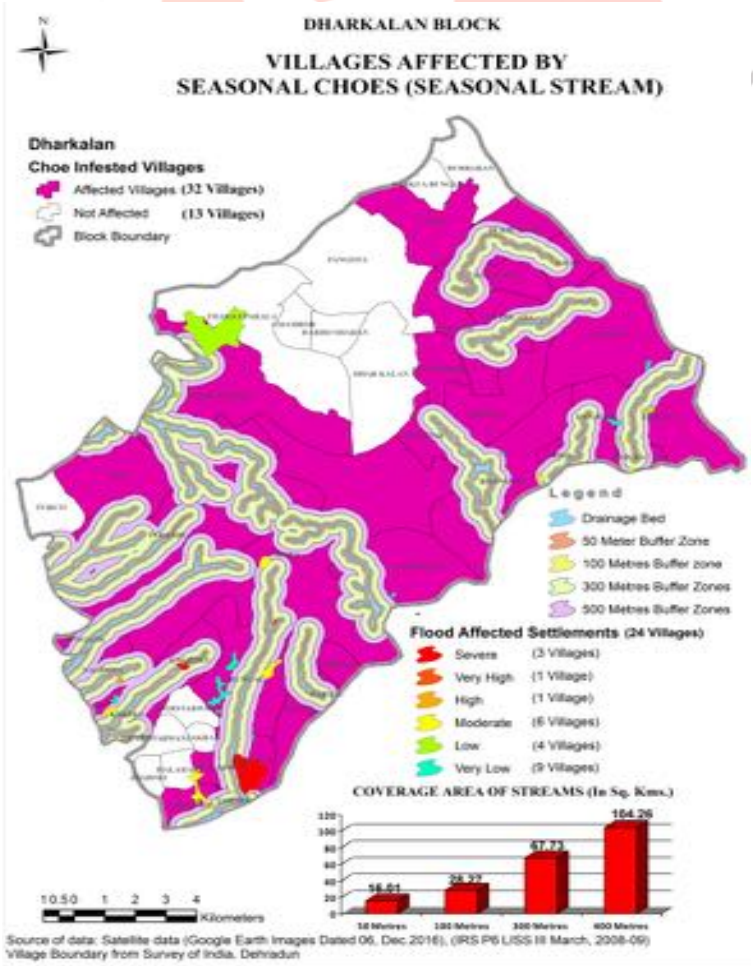

Figure 4

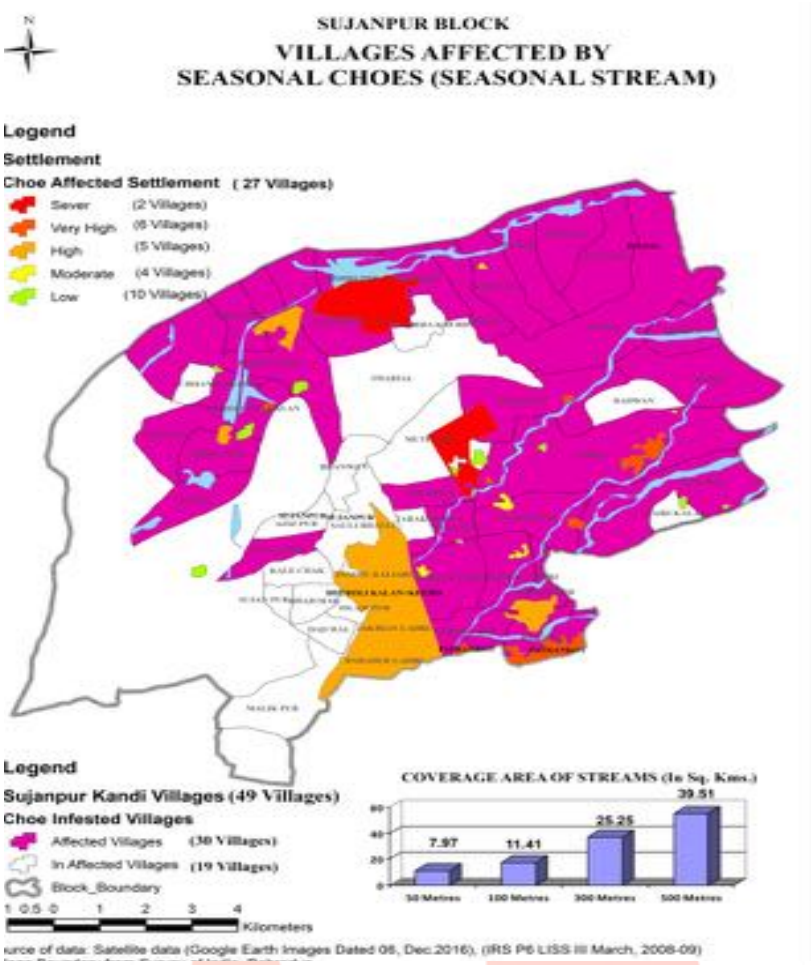

Figure 5

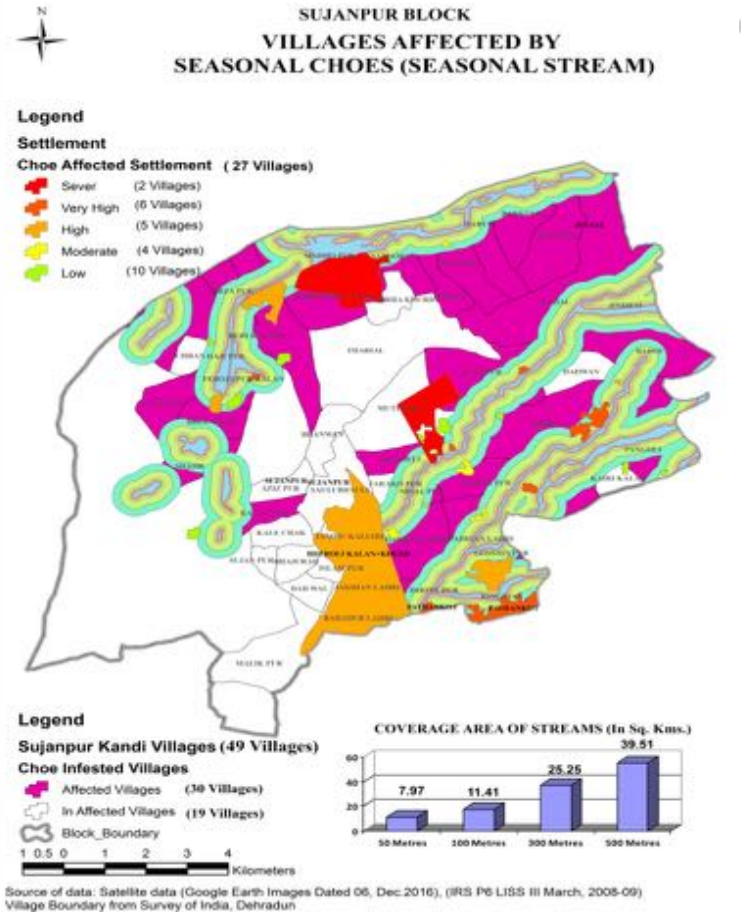

Figure 6

IV. RESULTS AND DISCUSSIONS

Identification of Villages under the Impact of Seasonal Streams:

Dharkalan and Sujanpur Blocks are amongst the most backward blocks of the Pathankot district. Majority of the region's population depend on agricultural activities and most of the farmers are landless agricultural laborer having marginal land holdings (Jain, 1998). Physical constraints such as the abnormal rainfall, dissected foothill zone, soil erosions are quite prominent in the area.

Villages affected by the seasonal Stream (Choes)

In Dhar Kalan block, 32 villages out of 45 villages, are under the impact of flooding and agricultural devastation of the seasonal streams. This ratio is quite high as compared to other blocks of the region. While in the case of Sujanpur block, 30 villages out of 49 villages, are under the impact of seasonal streams (choes).

Coverage Area of the Seasonal Streams:

The multiple buffers have been created along the seasonal streams of the Dhar Kalan and Sujanapur blocks (Chowdary et. al., 2003). These buffers have been created at a distance of 50, 100, 300 to 500 meters simultaneously the areas under these buffer are as below:

Table no. 2, Area under multiple buffers of seasonal streams in Dharkalan Block

Sr. No.	Buffer in Meter	Total Area
1	50	16.01
2	100	28.27
3	300	67.73
4	500	104.26
	Total	216.27

Source: IRS Resourcesat 1 LISS III, Jan & Feb. 2014, 2016 from Bhuvan Offical Site.

Table no. 3 The area under multiple buffers of seasonal streams in Sujanpur Block

Sr. No.	Buffer in Meter	Total Area
1	50	7.97
2	100	11.41
3	300	25.25
4	500	39.51
	Total	84.14

Source: IRS Resourcesat 1 LISS III, Jan & Feb. 2014, 2016 from Bhuvan Offical Site.

Identification of villages with severity level:

The Villages come near to the proximity of the buffer zone such as 50 meters are considered as having high severity. The villages far away from the buffer zone such as in the range of 500 meters have been considered as low severity villages.

In Dhar Kalan block, Jandwala, Gagroli are severely choe infested villages. Whereas, on the other hand, Rohg, Bakhatpur, Hara, Bhungal, Kakroli, and Nagrota are the moderate choe infested villages.

In Sujanpur block, Madhopur, Jhanjeli, Mutfarka are severely choe infested villages, and Ghoh, Khanpur, and Ranipur are very high choe infested villages. Sujanpur (Town), Mirjapur, Bhol Chak, Beri Buzarg and Goassinpur are in the category of high choe infested villages.

V. CONCLUSION

Kandi region has a sub-mountainous badland topography, which is numerously affected by the seasonal choes (seasonal rivulets). The region has a wide potential for vegetables, horticulture and dairy farming. It has a wide scope in the earth filled dams and rainwater harvesting structures which will reduce the problem of water scarcity in the region. Similar conclusions have also been drawn by Krishan et.al. (1998). The ravine lands which are inaccessible for agriculture can be put under forestry and orchard plantations. Soil erosion can be prevented by the practice of mixed cropping, which reduces land denudation by providing a maximum canopy and avoiding beating action of raindrops. Dhillon and Dhillon (2003) have similarly referred for preventing soil erosion in such conditions. To conclude it may be suggested that micro level planning through constructing check dams and introducing mixed cropping would be helpful in controlling the soil erosion and managing the water resources of the region.

REFERENCES

[1] Chowdary, V. M., Rao, N. H. and Sarma, P. B. S. 2003. GIS-based decision support system for groundwater assessment in large irrigation project areas. *Agricultural Water Management*, Vol. 62 (2003). Pp. 229–252.

[2] Dhillon, K.S. and Dhillon, S.K. 2003. Distribution and management of seleniferous soils. *Journal of Advances in Agronomy*, Vol. 79. Pp. 119-184.

[3] Government of India, 2011. Primary Census Handbook, Pathankot, 2011. Government of India, New Delhi.

[4] Jain. P.K. 1998. Remote sensing techniques to locate groundwater potential zones in upper Urmil River basin, district Chatarpur-central India. *Journal of Indian Society of Remote Sensing*, Vol. 26. Pp. 135-147.

[5] Jolly, Rajesh. 2003. *Application of Remote sensing and GIS technology for micro level planning in the dissected foothill zone: A case study of Raipur Rani Block, District Panchkula, Haryana*. Postgraduate Diploma in Remote Sensing and GIS dissertation, Department of Geography, Panjab University, Chandigarh

[6] Krishan, Gopal, Julka, A.C. and Singh, Mehar. 1998. *Integrated Development Plan for Anandpur Sahib Block, Rupnagar District, Punjab*. Block Development Plan submitted to Government of Punjab, Chandigarh.
[7] Sharma, G. N., Bath, S. K., Jolly, Rajesh. and Dhiman, Satyadeep. 2007. *Mapping of S&T needs Inventorization and documentation of location-specific problems requiring scientific/technical interventions in Punjab*. Project submitted to Punjab State Council for Science and Technology, Chandigarh.
[8] Singh, Chander Kumar et.al. 2011. Application of GWQI to Assess Effect of Land Use Change on Groundwater Quality in Lower Shiwaliks of Punjab: Remote Sensing and GIS Based Approach. *Water Resource Management*, Vol. 25. Pp. 1881-1898.
[9] Singh, Prabhbir and Khanduri, Kamlesh. 2011. Land use and Land cover change detection through Remote Sensing & GIS Technology: A Case study of Pathankot and Dhar Kalan Tehsils, Punjab. *International Journal of Geomatics and Geosciences*, Vol. 1, No 4. Pp. 839-846.
[10] Sharma, P.K. et. al. 2004. *Landuse/ Landcover cum drainage mapping in the selected sub-watershed in the Kandi area of Punjab*. Scientific Note PUNSEN-TR 2004. Punjab Remote Sensing Centre, P.A.U., Ludhiana.