

Change in River Channel Due to Expansion of Urban Places: - A Case Study of Karjat City along River Kanola

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Abstract:

Urban expansion in any region affects more rivers in the area because the percolation capacity decreases due to construction. Expansion of urban places along the river is a serious problem all over the world. River plays a very important role in the establishment of settlement. It changes the overall channel geometry, channel pattern, riffle pool sequence in other words all the flow and form variable. The River Kanola is one of the major rivers in the Bhima basin and it is a right bank tributary of River Sina. Karjat city is established on the bank of river Kanola. River Kanola has its source at Place Walvad. The height of the source is 693m and the order of the stream at Karjat is 5th. Cross-sections at these places have been taken to observe change in the area. Remote sensing data of 1991 and 2021 are taken into consideration. It has been observed and found that rural land use along the river Kanola is changed which is displayed in the morphometry of the channel, slope, and cross-sectional area of the channel. Most of the change was found in the form of construction and also making concrete roads in the channel because of which the channel width is reduced at this place more than 50%.

At the outset, we can say that the process of urbanization is the utmost requirement for the development of the region but it should be controlled by local people so that, development of the region through urbanization without disturbing the state of equilibrium of the river will run simultaneously.

Keywords: - River Kanola, Channel morphometry, Urban intervention, land use.

Introduction:

Urban expansion is a need of development and growth of the cities. But a lot of land is transformed into new buildings around streams. This transformation influences the physical process of river flow dynamics and subsequently changes stream characteristics. It also affects the water and soil quality in the surrounding area. Another point is that habitat in river also gets disturbed.

Effects of urbanization are more on human population and environment. Rivers are the important domain where a direct and continuous change takes place because of the urban disturbances. Urban transformation or expansion is a large process of development where the population in the cities increases rapidly. Present study is focused on 5 major streams of Ahmednagar district having 10 cities in which rivers are flowing. Effect of urbanization on these rivers is on a large scale therefore techniques like increase in infiltration rate and storage of excess water will help to reduce. River basins throughout the world are suffering from anthropogenic pressures like urbanization, industrialization and population growth resulting into river basin changes. Most of the population lives on banks of river basins therefore changes in river channels due to human intervention require extensive research.

The river Kanola influenced by urbanization around Karjat city and its morphology clearly shows this. Urbanization is going parallel with the river Kanola channel. We can observe that in the downstream direction of Kanola River with parallel rapid construction of new buildings in the river channel.

Industrialization is one of the important activity developments of urbanization i.e. education, transportation and other activities in the Ahmednagar city. Urbanization growth rate is rapidly increased ultimately it burdens on increasing land.

Review of Literature:

It has been opined by most of the environmentalists and geomorphologists that we can stop the development but the effects of urbanization can be controlled by some or other way. Cooke and Doornkamp (1990) has said that the most obvious manifestation of urban development is an increase in impervious cover and the corresponding loss of natural vegetation, land clearing, soil compaction, riparian corridor encroachment and modification to the surface water drainage network all typically accompany urbanization often quantified in terms of the proportion of basin area covered by impervious surfaces.

The study worked out by Gilewska (1964) focuses on the effects of hydraulic geometry of the Ekulu River in Eneku south eastern Nigeria the three section of river properties upstream of the town within the town and downstream of the town-urban hydrological routine due to urban drainage human traffic across the river banks. Gidding (2005) opined that landscape changes associated with urbanization have been showed to after flow regimes of stream that in turn after channel morphology aquatic habitat and biological communities in order to mitigate the effects of urbanization on biological communities, it is, important to understand the hydrologic links between these infractions. Stream bank vegetation significantly the morphology of streams in the piedmont region of the rivers allowing us to determine the combined influence of riparian vegetation and urbanization on channel morphology (Kale and Gupta, 2002). Rajgopalan (2005) in his environmental studies discussed the severe environmental degradation due to urbanization in which example of river Meethi and Dharavi slum is focused. Many others have also discussed many more aspects of urbanization on changing hydraulic geometry of river.

Aim and Objectives:

1. To study the channel morphology of river Sina.
2. The observation of the construction in river channel last 3 decades.
3. To observe the impact of urban expansion on river channel

4. Study Area:

The River Kanola is one of the major river in Bhima basin and it is a right bank tributary of River Sina. River Kanola has originate near Walvad, about 16 km North-west direction of Karjat city, at height 693 m ASL. Kanola basin spread over 398.35 sqkm. The town karjat is built on Right bank of the River. Town located at the height of 597 meters ASL. Latitudinal extent is 18° 32' N to 18° 33' N and longitudinal extent is 75° 00' E to 75° 44' E.

The total area of the Karjat city is 10.42 km² according to the 2011 census.

Major highways pass through Karjat city. One is SH 68 highway passes through the city. Urbanization rate is higher along the roads and river channel. Due to the road bridges and the building construction in the flood plain region, river channel has encroached and its impact on river channel morphology. Mostly, along the Bhandewadi road urbanization is rapidly increased due to the industrialization.

Karjat site along river Kanola

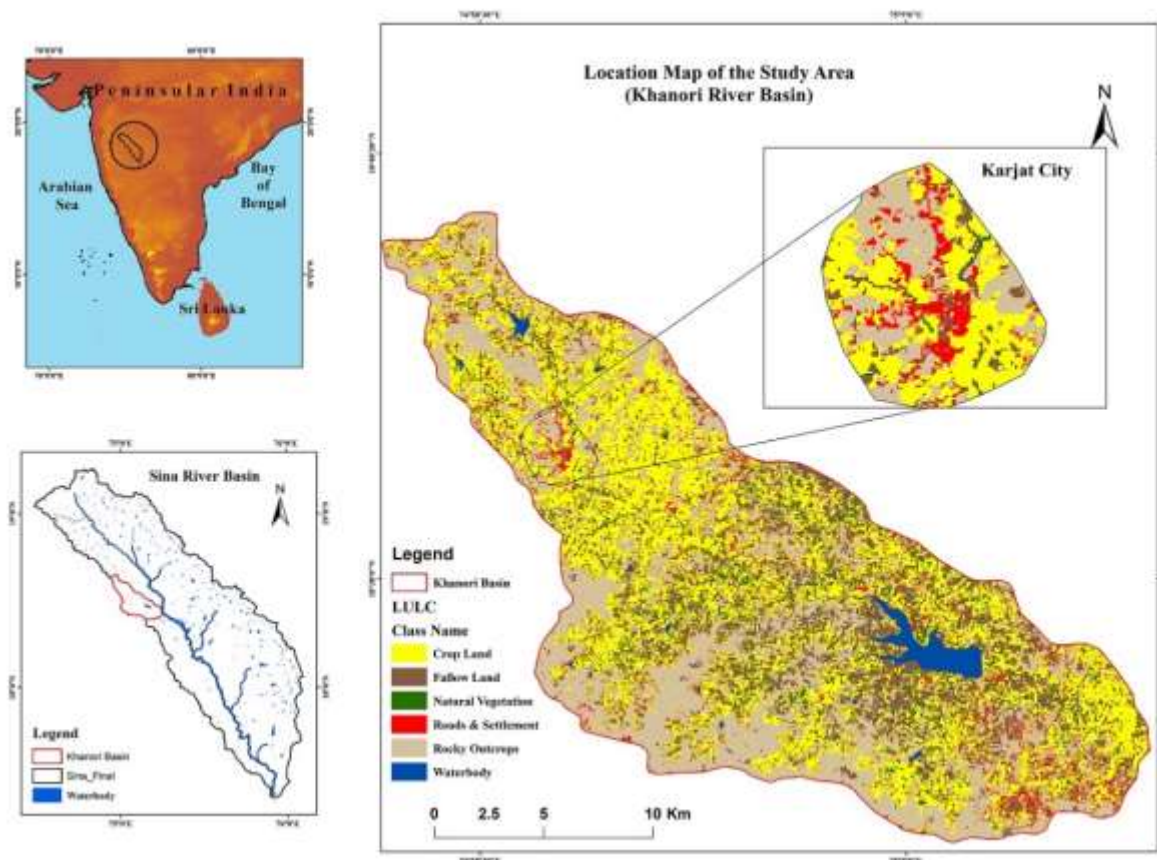


Figure - 1: Location Map of the Study Area

Material and methods

To find out the impact of urban development of the equilibrium state of the River Kanola is observed with the following points

- Field survey has been carried out to find out the effect of urbanization on channel morphology.
- Field measurement has been taken in the channel.
- Cross section and geomorphic sketches of area have been prepared.
- SRTM data

Following methodology is used for this research paper

- Demarcation of Kanola Basin from Survey of India toposheet No. 47 J/14, 47 J/15, 47 N/2 and 47 N/3.
- Digitization is completed with the help of Global Mapper v15.1 software and ArcMap 10.3 software.
- LULC is done using ERDAS IMAGIN 2014
- Various maps are prepared.
- Review of literature is carried out from different sources.
- Detailed morphometric analysis of the Kanola Basin is carried out.
- Detail Geomorphic Survey and cross section of River Kanola at Bandewadi Site along karjat City.

Table: 1.1 Status of different variable of Kanola basin

River Basin	Stream Order (u)	Number of Streams (Nu)	Streams length in km (Lu)	Log Nu	Log Lu	Mean Stream Lengths (MSL = Lu/ Nu)
5 th order Watershed	1	303.4	680.52	3.08	2.83	0.64
	2	142.2	228.93	2.48	2.35	1.50
	3	82.2	149.15	1.86	2.17	4.33
	4	26.2	69.60	1.25	1.84	6.55
	5	21.9	52.82	0.84	1.72	21.90
Total		595	575.9	6.73	10.19	10.24

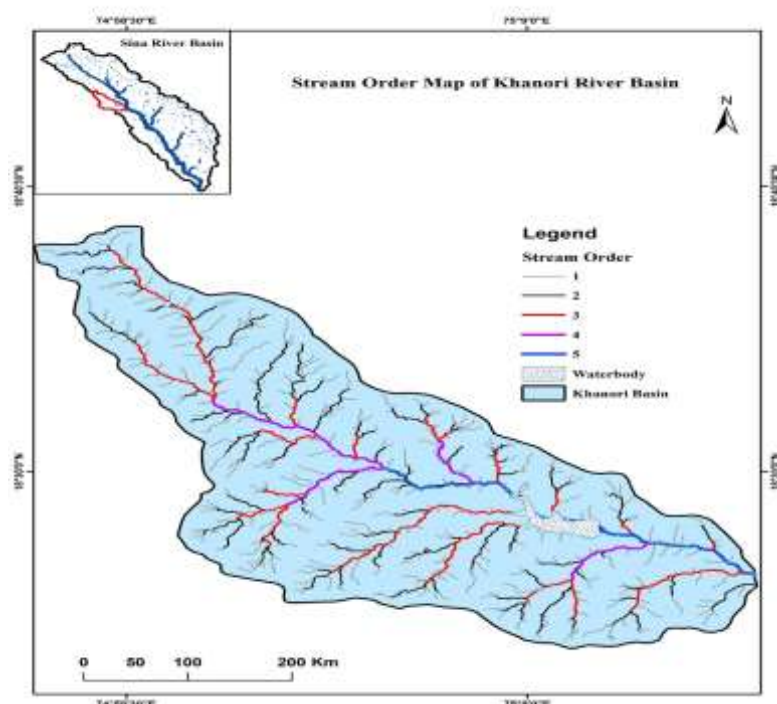


Fig.2: stream Order Map of Kanola River Basin

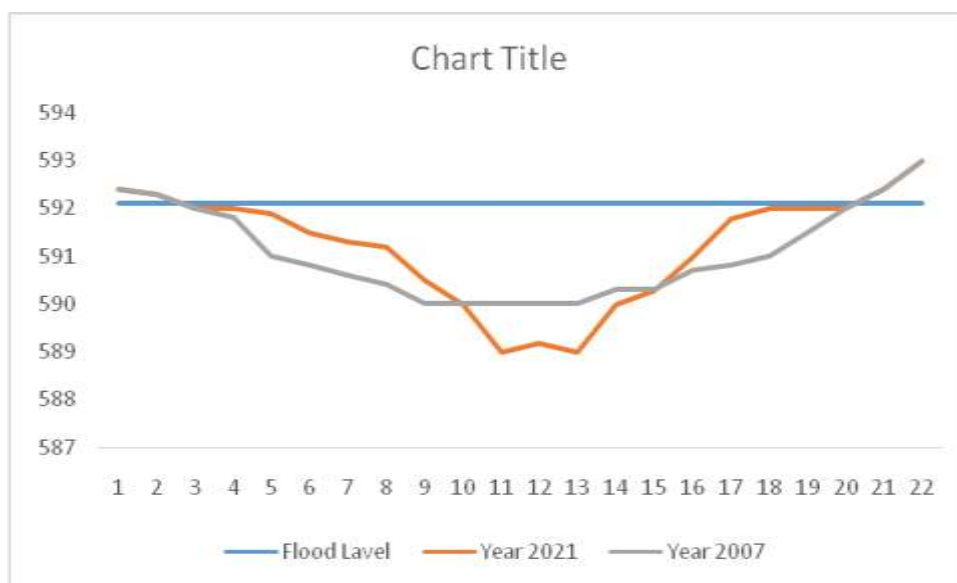
Table: 1.2 Areal variable of the Study Area

Drainage Density	1.45
Drainage Frequency	1.49
Form Factor Ratio	0.25
Circularity ratio	0.47
Elongation Ratio	0.57
Texture Ratio	2.16

Drainage characteristics of River Kanola

- **Stream Order:** - The stream ordering is doStrahler’s method and exhibited 5th order drainage basins.
- **Stream Number:-**total stream no is 595
- **Stream length:** study area length is 47.21km.
- **Bifurcation Ratio:-**the bifurcation ratio of the basin is 4.69
- **Drainage texture:-**the drainage texture 2.16
- **Drainage density:-** drainage density is 1.45

Fig: 3- Super Impose Cross profile of River Kanola

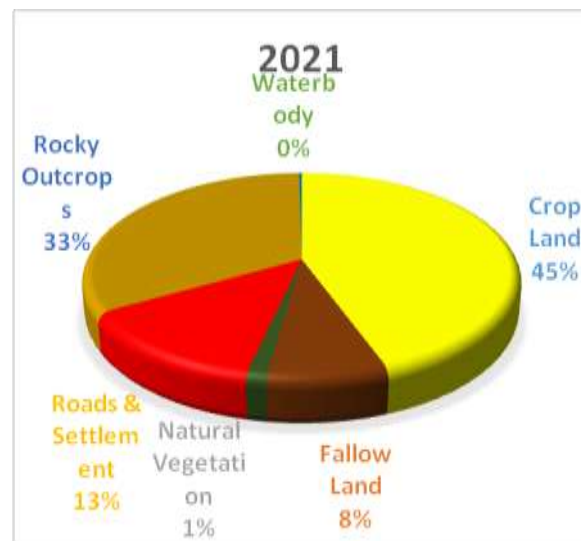
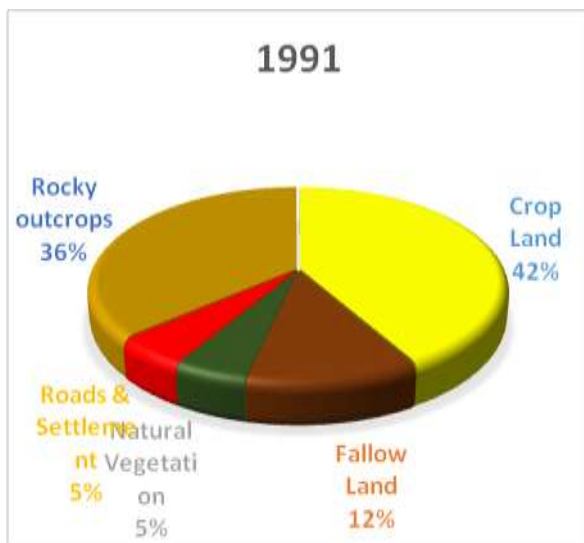
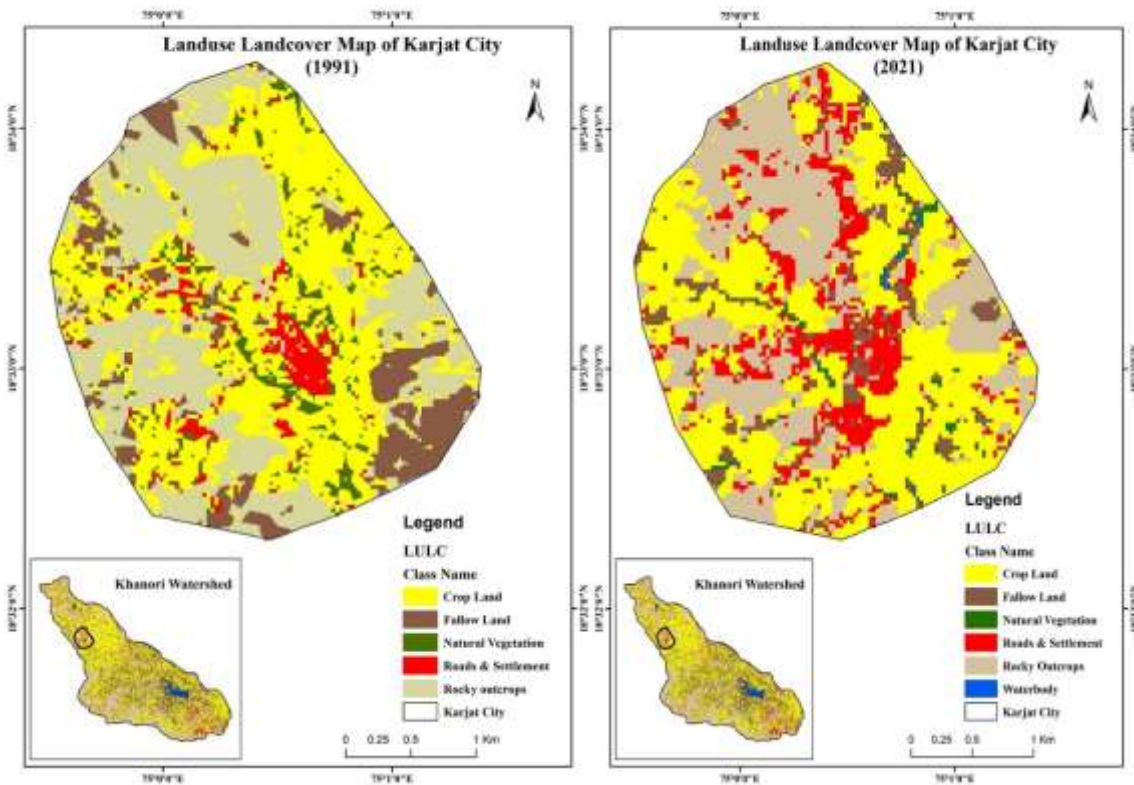


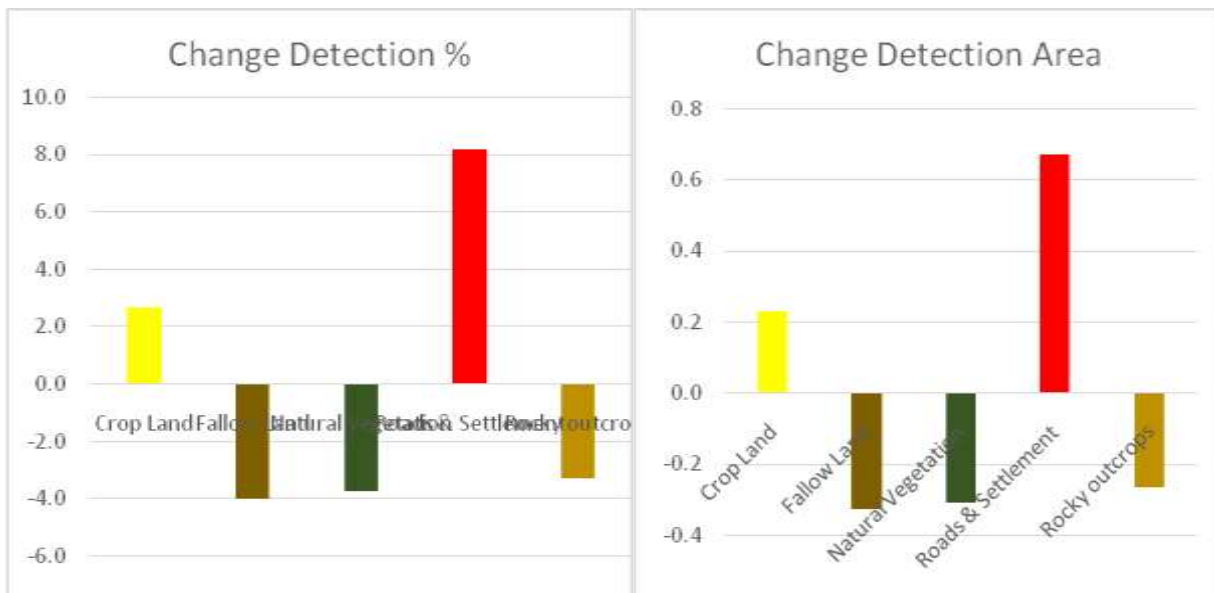
Bank width in 2007 is 107 m. which is reduce in 2021and remain 79 m. Cross section along the river at Karjat is taken at Bandewadi bridge place where maximum built-up is observed as are of the representative section. Cross section is taken and plotted for year 2007 and 2021.

Urban expansion along the river shows changes in width and depth of the channel. Most of the building construction or a type of the encroachment settle along the natural levees of the river or the active flood plain. This basin observed for the more than 10 years, which shows that the width of the channel is reduce by 27m. Whereas depth is increase from 1.7m to 0.9m. Width depth ratio is not proportional. Unequalproportional is due to expose rock in the bed. Banks are also of the compact material and hence encroachmentis on larger scale which leads to restrict the width. The nature of this cross section shows that after 100 to 200 meter of this patch channel turn in to mobile bed width is increased (126mets). Bank of these type are of loose heterogeneous material. Material brought from rocky bed with high velocity spread at number of places, which form the mounds like structure which have given space to increase the riparian vegetation in the channel. Due to this mounds the channel is bifurcates in the number of small stream, which resemble to braiding pattern. There for we can say that channel pattern morphology and hydraulic geometry is control by the urban structure.



River Kanola at Bandewadi Bridge
LAND USE LAND COVER OF KARJAT CITY





- Above land use land cover maps shows the significant change in land use pattern of the study area. In 1991 the buildup area is 5%. It increased 13% in 2021.

Sr. no	Class	1991 Area in % A	2021 Area in % B	Cumulative frequency	Cumulative frequency	Absolute Cumulative frequency (Crf ₁)	Absolute Cumulative frequency (Crf ₂)	Difference (Crf ₁)- (Crf ₂)) D
1	Crop Land	41.7	44.4	41.7	44.4	0.417	0.444	-0.027
2	Fallow Land	11.9	7.9	53.6	52.3	0.536	0.523	0.013
3	Natural Vegetation	5.1	1.3	58.7	53.6	0.587	0.536	0.051
4	Roads & Settlement	5.1	13.2	63.7	66.8	0.637	0.668	-0.031
5	Rocky Outcrops	36.3	33.0	100.0	99.8	1	0.998	0.002
6	Waterbody		0.2		100.0	0	1	-1
		100	100					0.972

For the comparison of 1991 and 2021 land use analysis Kolmogorov-Smirnov (KS) Test is applied and result shows that Null Hypothesis is rejected. Which shows that there is difference in land use pattern of 1991 and 2021 due to different urbanization level.

Results and Discussion

- All the natural channels always try to keep balance between rate of change due to local development.
- River Kanola shows the change in the flow and form variable, as a result of interventions. Bank full width of the channel is decreased and depth is increased at 2 points.

As mention in Cross section analysis width is decrease and depth is increased by 27m. It was also decided to observed to find out the changes in channel after how much distance begins,(though it is totally based on characteristic of river flow slope, lithology and climatic characteristics of the area) it depend on and nullify of the result of intervention approximate up to the which distance. Unfortunately in the case of River Kanola at Karjat there is another structure of KT ware around 1.5km is found. Effect of location A (hospital) is combined with the effects of location B (KT ware) shows increase in width by 142m

Conclusions

- As large number of Research studies come to the conclusion that most of the rivers of the world adjust their geometry with the natural and anthropogenic changes which is also observed at river Kanola at karjat.
- Finally it is development in the region which more in form of type at surface is a major cause for low infiltration. Hence the flash flood occurs in the area and change the characteristics of the channel.

References:

- **Legget, R.F., 1973.** Cities and Geology. McGraw-Hill, New York. pp. 579.
- **Mulder, E.F.J., McCall, G.J.H., and Marker, B.R., 2001.** Geosciences for Urban Planning and Management. In Marinos, P.G., Koukis, G.C., Tsiambaos, G.C. and Stournaras, G.C. (eds.) Proceedings International Symposium on Engineering Geology and the Environment (Athens, 1997), Balkema, Rotterdam. Vol. 4. pp. 3417-3438.
- **Maria J.A., Helder I.C., Alberto G., Paulo F., Jose M.M., Laura G., Lucia G., Jose T., Jose M.C. and Fernando T.R., 2006.** Urban Hydro-geomorphology and Geology of the Porto Metropolitan Area (NW Portugal). IAEG. Paper Number 92. pp. 1-9.
- **Cooke, R.U. 1976.** Urban geomorphology. Geographical Journal. Volume 142. pp. 59-65.
- **Cooke, R.U., Brunsdon, D., Doornkamp, J.C., and Jones, D.K.C., 1982.** Urban geomorphology in Drylands. Oxford University Press, Oxford, pp. 324.
- **Cooke and Doornkamp (1990)** 'Humans as Agents of landscape change: The Geomorphology of stoke – on Trent'.
- **Ahnert, F., 1998.** Introduction to Geomorphology. Arnold. pp. 352.
- **Giddings, E.M. (2005)** 'Hydrologic Links among Urbanization', Channel Morphology.
- **Kale, V. S. and Gupta, A. (2002)** 'Introduction to Geomorphology', Published by Geological Society of India, Bangalore.
- **Gazetteer of India (1997)** 'Maharashtra state, Ahmednagar District Gazetteer',
- **Gilewska, S. (1964)** 'Changes in the Geographic environment brought about by industrialization and urbanization', Problems of applied Geography, Vol. 2, and pp.:201-210.
- **Jeje, L. K. and ikeazota, S. I. (2002)** 'Urban Environment and Rivers', Singapore Journal of Tropical Geography, Vol. 23, Issue 1, pp.:37-51, March 2002.
- **Ranbir S. Kang, Richard A. Marston, 2006.** Geomorphic effects of rural-to-urban land use conversion on three streams in the Central Redbed Plains of Oklahoma.
- **Survey of India, Topo sheet: 47 J/14, 47 J/15, 47 N/2 and 47 N/3.**
- **Walling, D. E. (1981)** 'Hydrological processes, in Man and Environmental Processes', Edited by K. J. Gregory and DD Walling, Butterworth, pp.57-81.

BOOKS:

- **Strahler A. N:** Quantitative geomorphology of drainage basins and channel networks, in: V.T. Chow (ed.), Handbook of Applied Hydrology. McGraw Hill Book Company, New York, in 1964.
- **Singh S:** Geomorphology, Prayag Pustak Bhawan, Allahabad, 1999.
- **Dr. Mary J. Thornbush and Casey D. Allen:** Urban Geomorphology: Landforms and Processes in Cities, 1st Edition, 2018

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