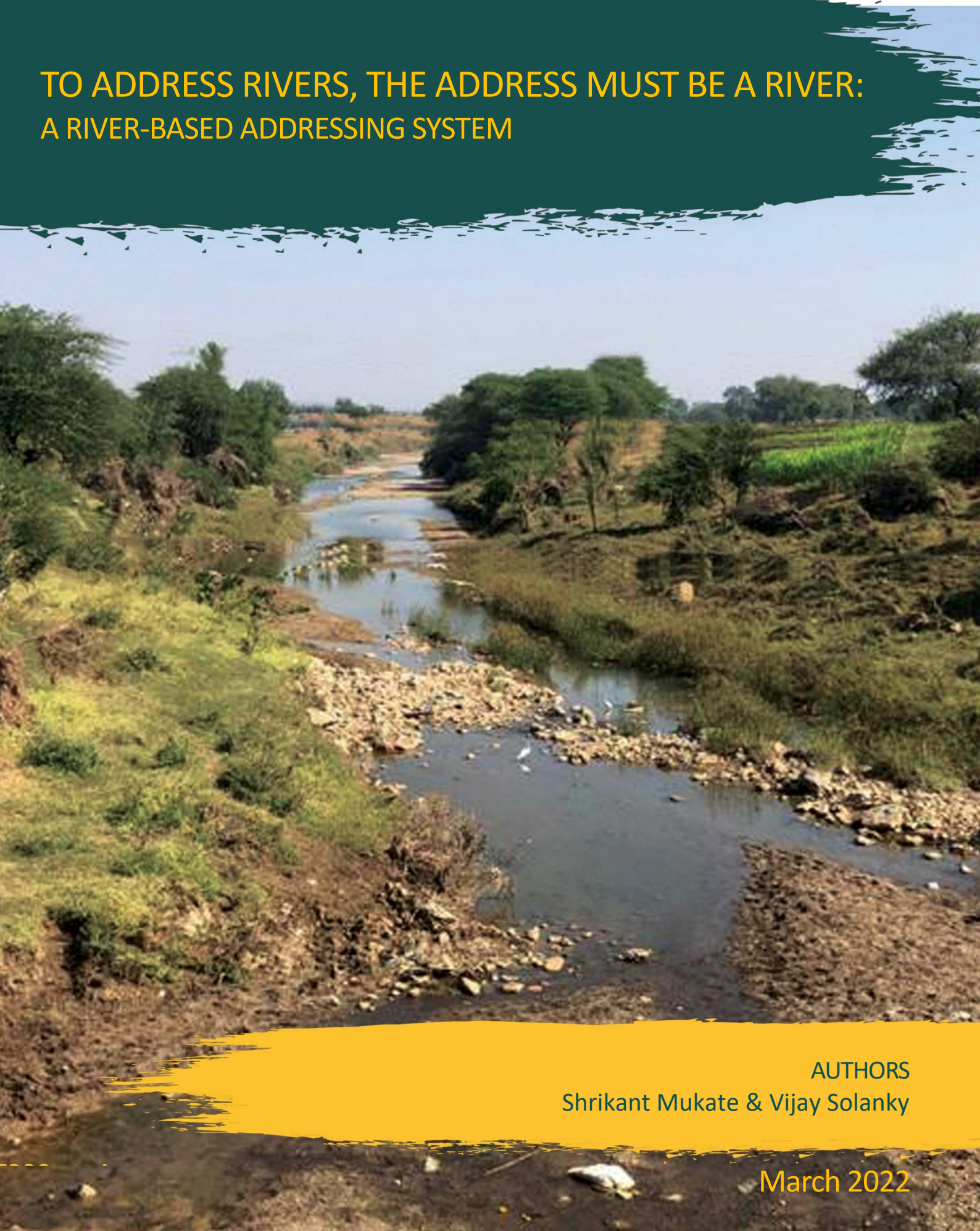
TO ADDRESS RIVERS, THE ADDRESS MUST BE A RIVER:
A RIVER-BASED ADDRESSING SYSTEM



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Keywords

River-based Address System, Human-River Connection, River restoration

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Abstract

The river has its importance geographically, ecologically and culturally in a country like India. But with ever increasing population pressure and poor governance has degraded rivers into the drains. Rivers in urban and industrial areas are utilized for disposing wastewater of domestic and industrial units. It is also important to note that even after spending thousands of crores rupees there is not any significant change in the status of rivers, which can be attributed to the trust deficit of people to the importance of river. To address the trust deficit of the people or communities it is necessary to connect them with the rivers. Urbanization has always taken place along the rivers and any part of land is ultimately part of one or other drainage system. So, there is natural boundary of river which is called as ridge line or watershed boundary, and over the period of time that boundary became less significant in front of the administrative boundary like tehsil, district, state or country boundaries. Currently, people have more faith in administrative boundaries than the natural boundaries. People feels more connected with administrative boundaries than the watershed boundaries, and that is the major reason behind the trust deficit. To connect the people with their watershed/ rivers, a framework has been prepared which will generate an address of the villages on the basis of catchment of river which they belong. For the present study Purna River basin, a tributary of Godavari River has been selected. The addresses of 118 number of villages has been prepared and communicated to the villages. The river address in text format may found uninteresting to read or write, to avoid this we have prepared a QR code and fastened into the village administrative office, schools and places where people gather regularly. After scanning QR code they will get a map of the basin in which they live along with the highlighted location of their village and text address for the same. With this addressing system it was observed that many of the people unaware about the river orders in which they live. The major behavioural change felt that they became aware about the complete drainage system of the tributary and River, which will help to plan and adopt the basin level plans. This address system will be helpful for researchers to identify the regional issues and planners to prepare an area specific plans.

Introduction

With the inception of industrialization or even before that to manage the regular affairs we prepared the administrative boundaries and generated the location specific address. Theses addresses are unique and robust and used to offer multiple services. In India, address mainly follows the administrative blocks prepared for the smooth functioning of administration, largely which follows the Country, State, District, Block, and Village and pin code. The administrative addresses were made for the purpose of revenue collection and for the better governance or management of the people and resources in the region. Currently, India is divided in 28 states and 8 union territories, these are further divided into 23 postal circles (Lobo, 2020), which are further divided into regions, divisions and subdivisions. This system is used to address the location of individual for communication and other purposes.

Unfortunately, with the adoption of administrative address system we forgot the watershed addresses, the river basin in which we live. In India the Indus valley gave rise to the ancient civilization which holds great historical value, since that time people were recalled by their origins and that occurred mostly in the valleys of rivers. For example the people from Indus valley, Ganges Valley, Brahmaputra Valley like references are common in the history of India and similarly, it may applies to the rest of the world. With the popularity of administrative addresses, river addresses phased out completely which brought the dis-connectivity of people with the rivers, which lead to the disastrous status of rivers in India and at many places around the world. A report of Down to Earth (2019) suggests that 20 basins of India are over exploited due to human interferences. Due to this human interference main impact is on the availability of the water in basin reduced considerably. To address the current situation of rivers there is a need to connect the people with rivers.

India is drained by many perennial and seasonal rivers and their tributaries (Singh, 2017). Watershed delineation originated to understand the River's geographical extends throughout the country. In India delineation and codification of watersheds in India carried out for the watershed planning at national and state level. The delineation has categorized the river system into different segments based on the following nomenclature *Water Resource Regions* and their subsequent division and subdivisions into *Basins, Sub-basins, Catchments, Sub-catchments, Watershed, Sub watershed and Micro-watersheds* in decreasing size of the delineated hydrologic unit. At the end this system generates one unique alphanumeric code (for e.g. 2A1C1b) which identifies the particular watershed of the India (Anon, 1990). This nomenclature basically evolved for the purpose of watershed treatment programs or implementation of interventions to treat watershed for soil and water conservation programs initiated by the Government of India. The generated watershed code i.e., 2A1C1b is solely for the implementers and that does not make any sense to the civilians. The code is difficult to remember and understand for laymen, due to the alpha numeric composition. So, this codes does not have any direct connect with the people and the existing river classification systems. The connection of people with river or watershed has been is lost over the period of time which resulted into the ruined condition of the river. Only the people living beside the river knows that they are living on the bank of that particular river but the people living far away are not sure about their catchment or major river. To establish the connection and make people aware there is a strong need to develop a bond between river and the people *'if we want to address our rivers, our address must be a river'*. Here, the attempt is made to establish

a connection of the people with their surrounding river. It will help them aware about the preset water resources, utilization and conservation sustainably. The objectives of the current study are a) to generate an address for a village which will be directly linking people to their rivers b) to communicate the importance of rivers innovatively to sensitize the people on river. This addressing system will play a crucial role to raise the awareness on the rivers and their issues locally. This address will help to improve the management of the Rivers through public participation to maintain the sustainability of the rivers.

Methodology

The methodology to generate river based addresses includes two important steps, the classification of rivers and the generation of codes. The existing rivers are classified in a way which can be used by anyone to prepare a code for their locality. In the current study codes are generated in two different format one is numerical code and QR code. The 14 digit numerical code and the map of the village based on river classification is embedded in QR code.

River Classification:-

1. Destination: The, majority of the Indian rivers travels to the Bay of Bengal followed by Arabian Sea. Few rivers are ephemeral in nature which vanishes off in hot deserts and few travels to other countries and later on meet to sea/ocean.

   1 –Bay of Bengal
   2 – Arabian Sea
   0 – Ephemeral / Transboundary River

2. Water Resource Regions (WRRs): The six WRRs suggested by Khosla in 1949 (Kumar Navin, 2014) have been adopted, however one more WRR is added to address Transboundary Rivers.

   WRR 1 – Indus drainage
   WRR 2 – Ganges drainage
   WRR 3 – Brahmaputra drainage
   WRR 4 – East-ward flowing Peninsular Rivers
   WRR 5 – West-ward flowing Peninsular Rivers
   WRR 6 – Ephemeral drainage (Western Rajasthan)
   WRR 7 – Transboundary Rivers apart from Indus

3. Basins**:** Among these seven WRRs, Central Water Commission (CWC) of Govt. of India classified different river basins like Ganga, Godavari, Krishna or a combination of smaller ones which are contiguous to each other, such as basin between Cauvery and Krishna. Each WRR contain more than one river basin.

4. Sub-basin: Again, CWC classified each river basin is divided into smaller sub-basins. In case of Godavari River, there are eight sub-basins. Namely, Upper Godavari, Middle Godavari, Manjara, Wardha, Wainganga, Pranhita and Others, Indravati and Godavari Lower.

5. Catchments: Each sub-basin is further divided into a number of catchments, which includes the major rivers of the sub-basin. For example sub-basin-Godavari middle has tributaries such as Sidda, Sudha, Asna, Purna, Sindphana and others.

6. Sub-catchments: The catchments are classified into a number of sub-catchments, which are mainly smaller tributaries and streams. For example the Purna River has six sub-catchments like Lower Purna, Dhamna, Kelna, Upper Purna, Girija, and Middle Purna. These sub-catchments are ordered in anticlockwise manner starting from the pour point of the sub-catchment.

7. Watersheds: Each sub-catchments has been divided into a number of watershed which are the smallest sized hydrologic unit. The sub-catchments are delineated for the different watersheds present. For example in Kelna sub-catchment there are three watersheds such as Ghankheda, Juie and Kelna

8. Villages: The village boundary is overlaid on the watersheds and the villages are identified falling in particular watershed. The villages dissected in two watersheds are classified on the basis of the area contributing to the respective watershed.

For the classification of river basins of India both CWC (Fig. 1) and WRIS-NRSC (Fig. 2) classification have been considered and the river basins are classified as represented in Table 1 & 2.

Table 1: Water Resource Regions (and Ocean/Sea code) with major rivers as per the CWC and WRIS-NRSC, ISRO

Destination Code	Water Resource Region Code	Water Resource Region Name
2 - (Arabian Sea)	**1**	Indus drainage
1 - (Bay of Bengal)	**2**	Ganges drainage
1 - (Bay of Bengal)	**3**	Brahmaputra drainage
1 - (Bay of Bengal)	**4**	East-ward flowing Peninsular Rivers
2 - (Arabian Sea)	**5**	West-ward flowing Peninsular Rivers
0 - (Ephemeral rivers and rivers travelling to other countries)	**6**	Western Rajasthan mostly ephemeral drainage
	7	Transboundary rivers apart from Indus

Table 2: Water Resource Regions and basins

Destination code	Water Resource Region Code	Water Resource Region Name	Basins
2 (Arabian Sea)	**1**	Indus drainage	1. Indus 2. Jhelum 3. Chenab 4. Ravi 5. Sutlej
1 (Bay of Bengal)	**2**	Ganges drainage	1. Yamuna 2. Ganga 3. Chambal 4. Betwa 5. Ghaghara 6. Kosi
1 (Bay of Bengal)	**3**	Brahmaputra drainage	1. Teesta 2. Brahmaputra 3. Barak
1 (Bay of Bengal)	**4**	East-ward flowing Peninsular Rivers	1. Subernrekha 2. Brahmani and Baitarni 3. Mahanadi 4. Mahanadi – Godavari 5. **Godavari** 6. Godavari – Krishna 7. Krishna 8. Krishna – Pennar 9. Pennar 10. Palar-Ponnaiyar 11. Cauvery 12. South of Cauvery
2 (Arabian Sea)	**5**	West-ward flowing Peninsular Rivers	1. Sabarmati 2. Mahi 3. Narmada 4. Tapi 5. Tapi – Tadri 6. Tadri - Kanyamumari
0 (Ephemeral rivers Transboundary rivers)	**6**	Western Rajasthan mostly ephemeral drainage	1. Luni 2. Saraswati
	7	Transboundary rivers apart from Indus	1. To Bangladesh 2. To Myanmar 3. To China and North

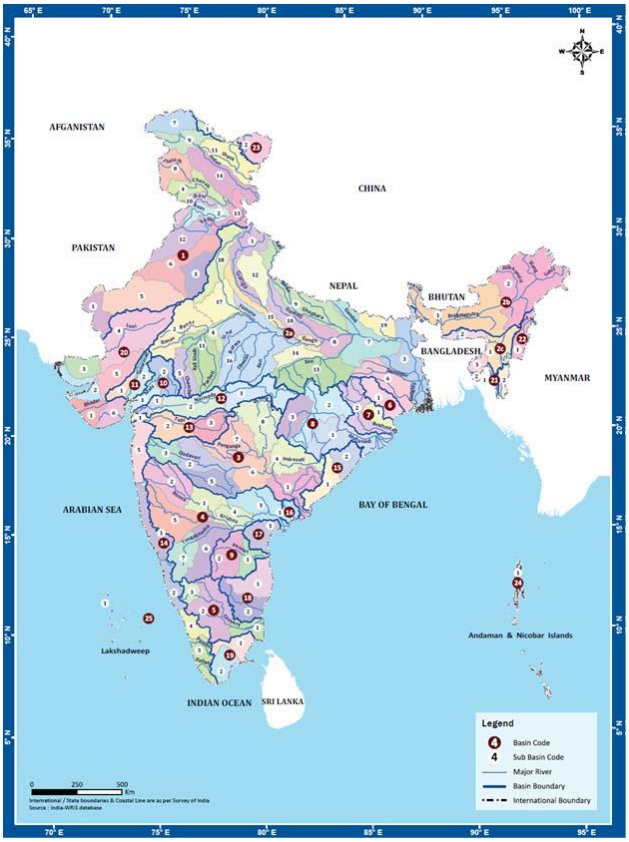

Fig 1: Classification of Rivers by CWC, INDIA

Fig 2: Classification of Rivers by WRIS-NRSC, ISRO, INDIA

Code Generation:

Numeric code**:** Destination and WRRs are the single digit value, they are expressed with single digit without adding zero in prefix, so a river with destination of Bay of Bengal from Water Resource Region four will be denoted as '14'. There are multiple basins in single water resource region and it may cross the single digit value, so it is represented by two digits i.e., 1st basin will be written as '01' and 11th basin as '11'. The classification of sub-basins is considered as suggested by the CWC and ordered from river origin to the mouth. So, numbering will start from the upper valley catchments and ends in delta region. Further the sub-basin is divided in smaller catchments which is composed of local rivers. The catchments of particular sub-basin are counted in anti-clock wise direction starting from the pour point of the sub-basin. In case of Middle Godavari sub-basin, Sidda as a first catchment and Kottur as a last catchment. Basin, sub-basin, Catchments, sub-catchments, watersheds and villages are represented with two digits. So, the code will be composed of numbers which are separated with hyphen at appropriate places as depicted in fig. 3. The first hyphen is placed to segregate the destination and water resource region. The second part of the code is composed of River basin and sub-basin. The next part of the code depicts the catchment and sub-catchment with two digits. Catchment signifies the Major River and sub-catchment as a minor rivers of that particular locality. Watersheds are delineated from the sub-catchments and village boundary is overlapped. Watershed and village numbering starts from the pour point of the watershed from right hand in anti-clockwise direction. The final numeric code will be as follows.

Fig. 3. Numeric code of the river based address

QR Code: To further simplify the above numeric code, a separate QR code for each village is prepared. The QR code will be composed of the map depicting the location of their village with respect to the river drainage of their geographic area and other information of their watershed/sub-catchment.

Study area

Godavari River basin:

For the current study, the Purna River has been selected which falls in Middle Godavari sub-basin of Godavari Basin (Fig. 4). The Godavari basin is the second largest basin in India after Ganga which covers about 9.5% area of the country (Figure 2). The land use land cover of the basin suggests that around 60% of the area is under irrigation followed by the total forest area i.e., 29% (CWC, 2014). It occupies the area of Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Chhattisgarh, Odisha and Pondicherry (Union territory) (Table 3). As per the Central Water Commission (Godavari 2014) of India report basin extends to 312,811.99 sq.

km, having a width of 583 km and length of 995 km, out of that 48.7% falls in the Maharashtra (Table 3) and is divided in eight different sub-basins as represented in Table 4.

Table 3: State wise drainage area

Sr. No.	State	Area (%)
1	Maharashtra	48.70%
2	Andhra Pradesh	23.70%
3	Madhya Pradesh	7.80%
4	Odisha	5.70%
5	Karnataka	1.40%
6	Chhattisgarh	12.40%
7	Puducherry	0.01%

Source: (CWC Report 2014)

Table 4: Sub-basins of Godavari River

Sr. No.	Sub Basin	Area
1	Godavari Upper	21,443.23 (7.1)
2	Godavari Middle	36,290.47 (12.01)
3	Manjra	29,472.88 (9.76)
4	Wardha	46,241.09 (15.31)
5	Wainganga	49,695.40 (16.45)
6	Pranhita and Other	36,119.60 (11.96)
7	Indravati	38,306.10 (12.68)
8	Godavari Lower	44,492.93 (14.73)

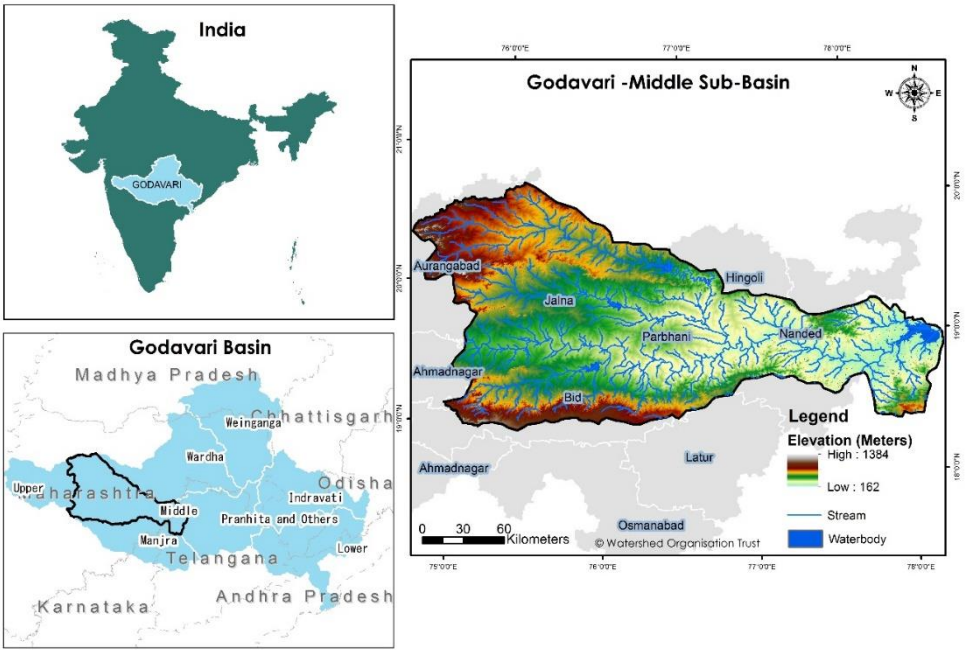

Fig. 4. Middle Godavari sub-basin of Godavari Basin

Middle Godavari River Sub-basin:

It is observed that Middle Godavari sub-basin has 16 major and minor rivers (Table 5). The rivers are listed in anti-clock wise manner. Purna River is the fourth major tributary falling on the left side of the river which originates in the Ajanta hill ranges of Maharashtra in Aurangabad district and flows in North-west to South-east direction through Aurangabad, Buldhana, Jalana, Hingoli and Parbhani districts (Figure 4). Purna River confluences with Godavari in Parbhani District near (Jambhul bet village) Purna Town. Purna river catchment covers an area of 15,579 sq. Km. Purna River is the largest river sub-basin covering majority of the area (Fig. 5) which is composed of 11 sub-catchments as depicted in Fig. 6. Administratively, these villages are spread across the five districts Aurangabad, Buldhana, Jalana, Hingoli and Parbhani and major towns includes the Bhokardan, Jalana, and Parbhani. The entire sub-catchment falls in semi-arid type, surface water is limited to few months, in summer most of the catchment faces water scarcity and drought like situation.

Table 5: Catchments of Middle Godavari sub-basin

Sr. No.	Catchments
1	Siddha
2	Sudha
3	Asna
4	**Purna**
5	Dudhna
6	Sindphana
7	Jayavanta/ti (Daunapur dam)
8	CWC Watershed no. 41
9	Galati (Masuli Dam)
10	CWC Watershed no. 43
11	CWC Watershed no. 46
12	Kahala
13	CWC Watershed no. 51
14	Haldi
15	Phulagan
16	Kottur

To implement river address system the Kelna sub-catchment is selected (Fig. 7). The river addresses for 118 number of villages were prepared and disseminated. The reason behind selecting the Kelna sub-catchment is the size of sub-catchment is small and local level support is available to spread the idea among local stakeholders. Kelna watershed is divided into three small watersheds, such as Ghankheda, Juie and Kelna. Details of these three watersheds are provided in following table 6.

Table 6: Villages and tributaries of Kelna

Sr. No.	Watershed	No. of Villages	Area in ha	Households	Population
1	Ghankheda	08		3244	15495
2	Juie	36		17108	84891
3	Kelna	74		32918	165643
Total		**118**	**5071.5**	**53259**	**266029**

Source: Census 2011

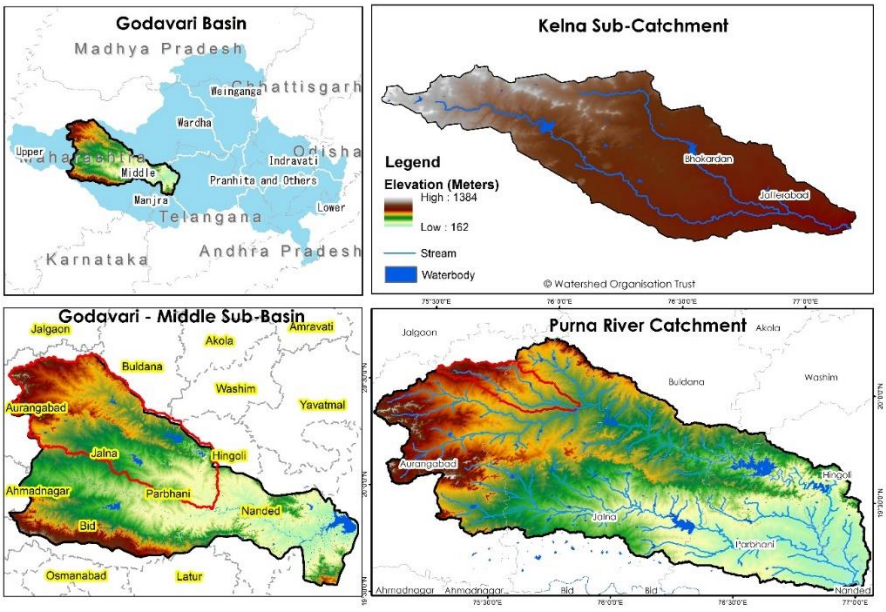

Fig. 5. Catchments of Middle Godavari sub-basin

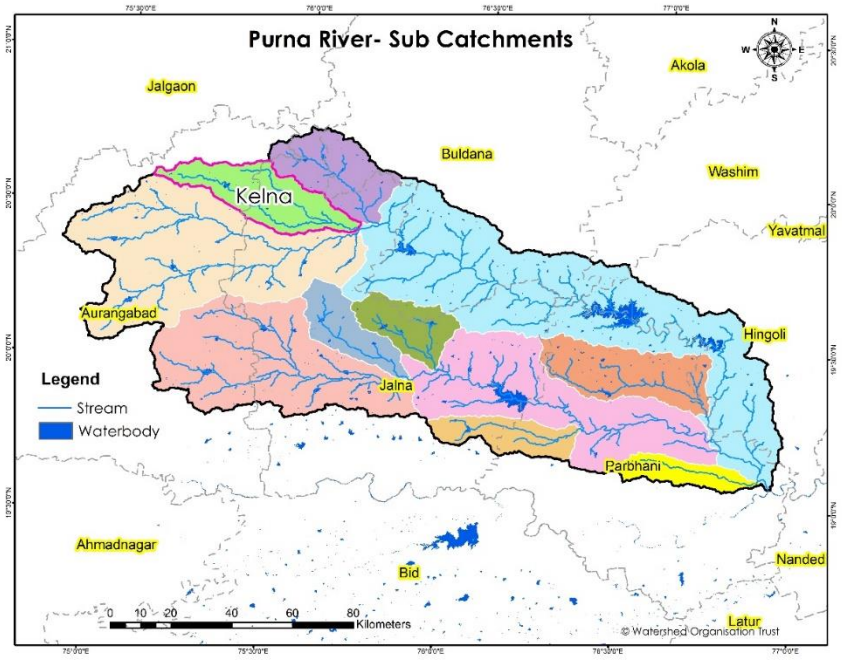

Fig. 6. Sub-catchments of Purna River

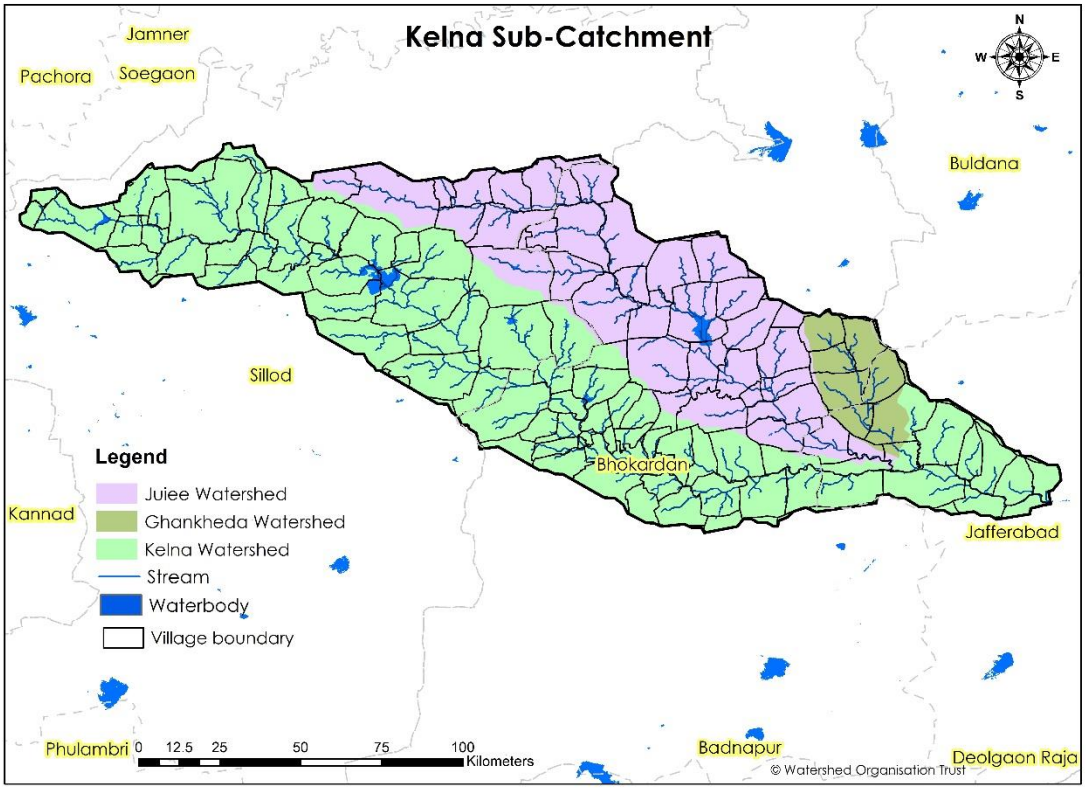

Fig. 7. Watersheds of Kelna sub-catchment

Results and Discussion

Development of river based address needs a proper classification of the rivers. For the current study middle Godavari river sub-basin of Godavari basin is considered. The destination of Godavari River is Bay of Bengal and it falls in the WRR-4 i.e., east flowing peninsular river. As Fig. 1 & 2, the list of East flowing peninsular rivers are updated where Godavari River appears at fifth position. Godavari basin is a huge and it is further classified into 8 sub-basins. CWC ordered the sub-basins from origin to mouth, in which Godavari middle falls at second number. The Godavari middle sub-basin is composed of 16 catchments of varying size. For the current study Purna catchment is selected which lies at fourth number as per the ordering criteria. The ordering of catchment starts from the confluence point in anti-clockwise manner. In Purna catchment there are six sub-catchments, out of which Kelna catchment is considered for the current study. Three watersheds of Kelna were delineated and village boundary map is overlaid. The ordering criteria for sub-catchments and villages is same as the catchment. The addresses for the villages present in those thee watersheds are prepared as represented in the following table. The numeric address of the Ghankheda village is 14-050204-0301-01.

Table 7: Numeric code generation criteria

Sr. No.	Classification Chronology	River Classification	Numeric Code
1	Destination	1 - Bay of Bengal	14
2	Water Resource Region	4 - East flowing Peninsular River	
3	Basin	**05 - Godavari**	05
4	Sub-basins of Godavari	Major Sub-basins 1. Godavari Upper 2. **Godavari Middle** 3. Manjra 4. Wardha 5. Wainganga 6. Pranhita & other 7. Indravati 8. Godavari lower	02
5	Catchments of Godavari Middle	1. Siddha 2. Sudha 3. Asna 4. Purna 5. Dudhna 6. Sindphana 7. Jayavanta/ti (Daunapur dam) 8. CWC Watershed no. 41 9. Galati (Masuli Dam) 10. Jayavanta/ti 11. CWC Watershed no 43 12. CWC Watershed no. 46 13. Kahala 14. CWC Watershed no. 51 15. Haldi 16. Phulagan 17. Kottur	04
6	Sub-catchments of Purna	Sub-catchments of Purna 1. Lower Purna 2. Dhamana **3. Kelna** 4. Upper Purna 5. Girija 6. Lower Purna	03
7	Watersheds of Kelna	Watersheds of Kelna **1. Ghankheda** 2. Juie 3. Kelna	01
8	Villages of Ghankheda	Number of Villages **1. Ghankheda**	01
			14-0502-0403-0101

Following the above classification system (Table 7), the numerical code of Ghankheda villages was prepared. The numeric address of the Ghankheda village is 14-050204-0301-01. To simplify this code, a text address for that village is generated. The text address is very similar to the existing administrative address, which will be quite easy to understand and relate to the rivers of their locality (Table 8). The map of the villages showcases the spatial location of the villages and its reference to the region's drainage system (Fig. 5). The river-based (text) address prepared for Ghankheda in local (Marathi) and English language (Table 8), which 209 households of Ghankheda can use to represent their household location in the drainage system of India. In the similar way, all the 118 villages falling in Kelna waterhed were addressed and their names and river pin codes are represented in Table 9.

Table 8: Representative text address of the Village (embedded in QR code)

Address in (Marathi) Local Language	Address in English Language
गाव : घाणखेडा पाणलोट क्षेत्र : घाणखेडा उपनदी : केळणा नदी : पुर्णा उप-खोरे : मध्य-गोदावरी खोरे : गोदावरी समुद्र : बंगाल चा उपसागर नदी कोड : १४-०५०२-०४०३-०१०१	**Village**: Ghankheda **Watershed**: Ghankheda **Sub-catchment**: Kelna **Catchment**: Purna **Sub-basin**: Middle Godavari **Basin**: Godavari **Destination**: Bay of Bengal **River code**: 14-0502-0403-0101

Table 9: Numeric code generated for the villages present in three watersheds of Kelna sub-catchment

Watershed	No. of Villages	Village Name	Households	Population	River Code
Ghankheda	1	Ghankheda	209	1047	14-0502-0403-0101
	2	Mahora	908	4475	14-0502-0403-0102
	3	Wadala	246	1294	14-0502-0403-0103
	4	Kotha Jahagir	297	1286	14-0502-0403-0104
	5	Malegaon	278	1268	14-0502-0403-0105
	6	Kolegaon	309	1551	14-0502-0403-0106
	7	Walsa Wadala	673	3215	14-0502-0403-0107
	8	Kolhapur	313	1359	14-0502-0403-0108
Juie	1	Bhorkheda	311	1448	14-0502-0403-0201
	2	Asai	414	1927	14-0502-0403-0202
	3	Borgaon Jahagir	486	2295	14-0502-0403-0203
	4	Tadkalas	178	842	14-0502-0403-0204
	5	Godri	454	2471	14-0502-0403-0205

	6	Warud bk.	519	2349	14-0502-0403-0206
	7	Wadshed	264	1360	14-0502-0403-0207
	8	Dehed	452	2070	14-0502-0403-0208
	9	Palaskheda Murtad	384	1980	14-0502-0403-0209
	10	Surangali	625	3259	14-0502-0403-0210
	11	Karajgaon	338	1700	14-0502-0403-0211
	12	Kalyani	410	1958	14-0502-0403-0212
	13	Kukdi	160	681	14-0502-0403-0213
	14	Anvapada	525	2860	14-0502-0403-0214
	15	Koda	311	1651	14-0502-0403-0215
	16	Dhonkheda	155	751	14-0502-0403-0216
	17	Dhotra	386	1828	14-0502-0403-0217
	18	Wadopan Kh.	436	1899	14-0502-0403-0218
	19	Golegaon Bk.	619	3609	14-0502-0403-0219
	20	Kajipur	36	156	14-0502-0403-0220
	21	Khandala	295	1477	14-0502-0403-0221
	22	Undangaon	1868	8752	14-0502-0403-0222
	23	Khullod	486	2274	14-0502-0403-0223
	24	Golegaon Kh.	438	2123	14-0502-0403-0224
	25	Wadopan Bk.	872	4293	14-0502-0403-0225
	26	Karlawadi	131	602	14-0502-0403-0226
	27	Anwa	1159	5656	14-0502-0403-0227
	28	Sarola	657	3108	14-0502-0403-0228
	29	Janephal (Gaikwad))	386	2167	14-0502-0403-0229
	30	Wakdi	644	3026	14-0502-0403-0230
	31	Kathora Bajar	793	4817	14-0502-0403-0231
	32	Dagadwadi	416	2076	14-0502-0403-0232
	33	Danapur	543	2800	14-0502-0403-0233
	34	Talni	164	795	14-0502-0403-0234
	35	Bhayadi	332	1677	14-0502-0403-0235
	36	Sipora	461	2154	14-0502-0403-0236
Kelna	1	Sawarkheda	116	516	14-0502-0403-0301
	2	Aradkheda	308	1408	14-0502-0403-0302
	3	Gokulwadi	129	617	14-0502-0403-0303
	4	Mhasarul	410	1630	14-0502-0403-0304
	5	Mahora	908	4475	14-0502-0403-0305
	6	Varud_Kh	299	1349	14-0502-0403-0306
	7	Dautpur	201	1009	14-0502-0403-0307
	8	Bhaglgaon	258	1367	14-0502-0403-0308
	9	Chorala	132	644	14-0502-0403-0309
	10	Viregaon	254	1271	14-0502-0403-0310
	11	Palaskheda_bhokardan	0	0	14-0502-0403-0311
	12	Alapur	187	1014	14-0502-0403-0312
	13	Manapur	193	979	14-0502-0403-0313

	14	Pralhadpur	99	517	14-0502-0403-0314
	15	Malkapur	220	1068	14-0502-0403-0315
	16	Wadi_Bk	359	1645	14-0502-0403-0316
	17	Wadi_Kh	167	834	14-0502-0403-0317
	18	Bhivpur	298	1534	14-0502-0403-0318
	19	Asadi	569	2905	14-0502-0403-0319
	20	Rahimabad	785	3692	14-0502-0403-0320
	21	Sarola	657	3108	14-0502-0403-0321
	22	Anvi	795	4309	14-0502-0403-0322
	23	Palodi	868	4285	14-0502-0403-0323
	24	Leha	503	2489	14-0502-0403-0324
	25	Khedi	288	1402	14-0502-0403-0325
	26	Mandna	499	2461	14-0502-0403-0326
	27	Mohal	186	855	14-0502-0403-0327
	28	Hatti	674	3511	14-0502-0403-0328
	29	Virgaon	212	897	14-0502-0403-0329
	30	Pangri	202	947	14-0502-0403-0330
	31	Ghatambri	531	2814	14-0502-0403-0331
	32	Ambhaii	1315	7220	14-0502-0403-0332
	33	Nanegaoni	503	3362	14-0502-0403-0333
	34	Janasii	87	423	14-0502-0403-0334
	35	Sirsala	237	1153	14-0502-0403-0335
	36	Kelgaon	636	2956	14-0502-0403-0336
	37	Adharwadi	175	999	14-0502-0403-0337
	38	Korhala	85	494	14-0502-0403-0338
	39	Pimpalgaon_Ghat	173	872	14-0502-0403-0339
	40	Shekhapur	69	397	14-0502-0403-0340
	41	Jambhai	347	1709	14-0502-0403-0341
	42	Relgaon	619	2956	14-0502-0403-0342
	43	Bojgaon	133	619	14-0502-0403-0343
	44	Wadala	246	1294	14-0502-0403-0344
	45	Sasurwada	216	1007	14-0502-0403-0345
	46	Bahuli	208	1106	14-0502-0403-0346
	47	Chinchpur	356	1644	14-0502-0403-0347
	48	Chandapur	192	993	14-0502-0403-0348
	49	Mangrul	251	1122	14-0502-0403-0349
	50	Dongargaon	1527	7685	14-0502-0403-0350
	51	Dahigaon	213	1082	14-0502-0403-0351
	52	Avhana	1039	5126	14-0502-0403-0352
	53	Gokul	210	1074	14-0502-0403-0353
	54	Perjapur	227	1188	14-0502-0403-0354
	55	Subhanpur	210	1003	14-0502-0403-0355
	56	Malkheda	297	1476	14-0502-0403-0356
	57	Nasirabad	16	103	14-0502-0403-0357

	58	Ibrahimpur	453	2366	14-0502-0403-0358
	59	Rajapur	39	209	14-0502-0403-0359
	60	Rampur_Bk.	23	134	14-0502-0403-0360
	61	Bhokardan	4544	24416	14-0502-0403-0361
	62	Jomala	81	527	14-0502-0403-0362
	63	Fattepur	572	2769	14-0502-0403-0363
	64	Masanpur	133	631	14-0502-0403-0364
	65	Garkheda	125	615	14-0502-0403-0365
	66	Lingewadi	392	1911	14-0502-0403-0366
	67	Baranjala_(lokhande)	480	2210	14-0502-0403-0367
	68	Kodoli	384	1876	14-0502-0403-0368
	69	Takli_bhokardan	229	1076	14-0502-0403-0369
	70	Pimpalgaon_Kad	343	1608	14-0502-0403-0370
	71	Jawakheda	541	2686	14-0502-0403-0371
	72	Varkheda_Vira	253	1220	14-0502-0403-0372
	73	Takli	183	864	14-0502-0403-0373
	74	Jafrabad	3249	15910	14-0502-0403-0374
Total	118		53259	266029	

The spatial location of the Ghankheda village is represented in Fig. 8, and the generated QR code is represented in fig. 9. The generated QR code embeds the spatial map and text address of Ghankheda village, and all the village have their QR code. Whenever the user scans the QR code, they will receive the respective river-based address. In the case of the Ghankheda village, the user will receive the output showcased in fig. 10 after scanning the QR code. In the current study, we have prepared the spatial location maps, text addresses in two languages, and QR codes for all the 118 villages in the Kelna watershed. The River pin codes of 118 villages are represented in Table 9. The QR codes offer a lot more flexibility for researchers to keep adding information from the remote place, and at the same time, this information is transferred to the people who need it most. So, it becomes easier to share the information from the knowledge generation community with the receivers. It will help people know the challenges their watershed faces and the best possible solutions to build resilience against climate vulnerabilities.

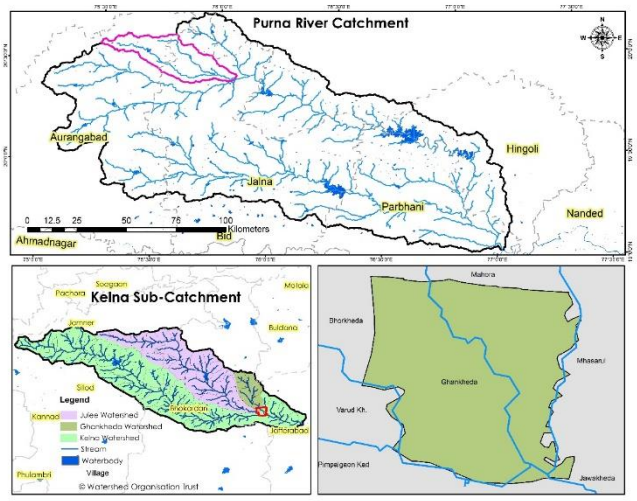

Fig. 8. The spatial location map of Ghankheda River address along with Text address

Fig. 9. QR code for Ghankheda Village

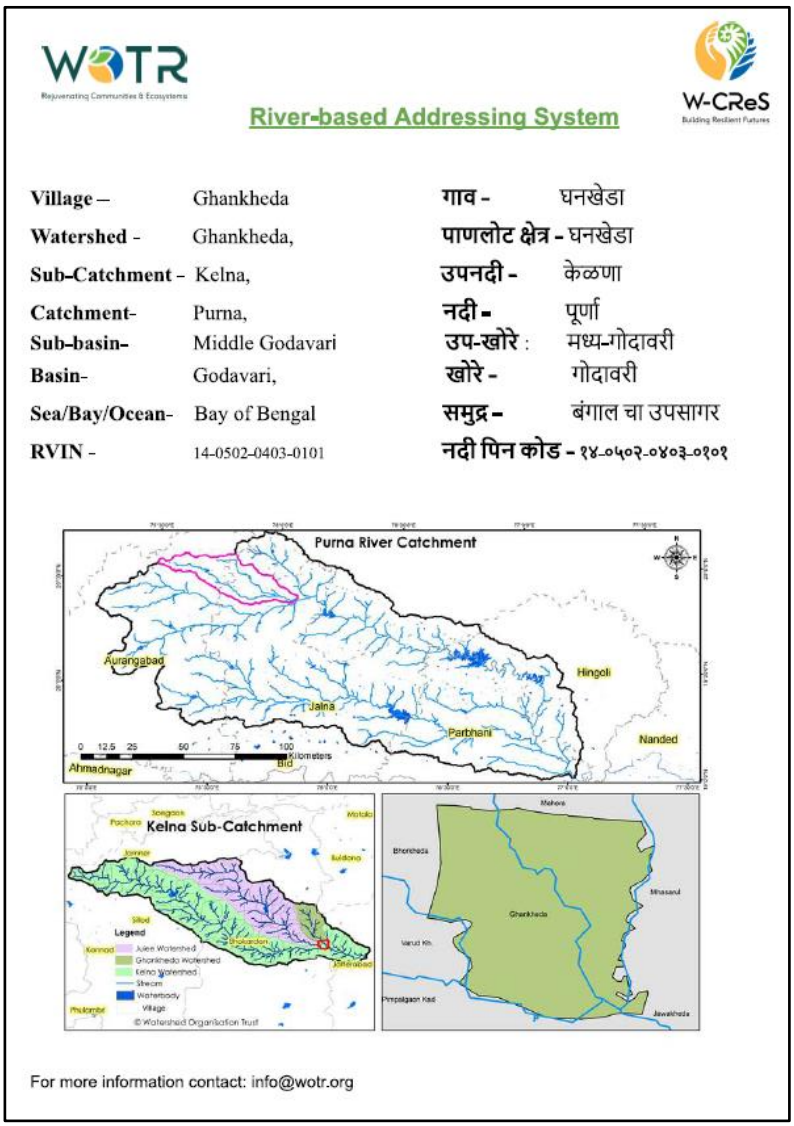

Fig. 10 Scanned QR code showcasing the spatial location map of Ghankheda River address along with Text address

This addressing system can be used to raise the awareness and Capacity building: The generated address will help people to know their spatial connectivity with upstream and downstream villages with respect to the drainage flowing nearby. The linage of people and their rivers is strengthened which will help to identify the locale issues of particular place. Accordingly, people can be capacitated with customized trainings/workshops with the stratified approach to solve their problems.

Resource planning can be done holistically: This River addressing system will be useful to conduct the vulnerability assessment at village level and watershed level to identify triggers of change and interventions for their sustainability from watershed to sub-basin and basin level. Even this can be calculated in earlier classification as well but the village wise data of each watershed is easily captured in this system. So, by having village level data the planners and policy makers will be in a better position to frame the policies and programs at village and block level.

Ridge to valley approach can be up scaled from first to last drain: The existing ridge to valley approach can be extended from Origin to Mouth / Origin to Delta / first to last drain. The individual units such as watershed to basin can be considered as an ecosystem in itself when it comes to restoration where people's participation and ownership is crucial.

Human Impact Assessment: LULC changes happening at watersheds can be identified and linked with the village level activities through the geographic information system and remote sensing. Even the formation of cluster of villages will be quite easy to with the help of river addresses and trends of change detection can be addressed with proper interventions.

Integration of existing tools for the sustainable development: The application of tools such as water budgeting can be implemented efficiently as the villages of same watershed will have more connectivity and that behavioural change may bring more unity among them.

Use of Biodiversity and Traditional knowledge: Through the QR codes the biodiversity and traditional knowledge of that locality can be linked up with the watersheds which will help us to focus on the local specific solutions with the lens of Ecosystem based Adaptation to build resilience.

Engagement of local communities can be extended to study the socio-economic and environmental interactions with the watershed to build resilience.

Role of Technology: As of now the generated QR code are composed of the text address (in local and English language) and map of the village in reference with the river system of that region and the numeric code. The QR codes adopted with the idea to update the maps periodically, with the information such as Population of the village, rainfall, temperature, soil type, infiltration rate, evapotranspiration rate, and also the published information such as research articles, blogs, and videos to spread the awareness on different aspects of their watershed and village.

Conclusions

This is a unique idea to reconnect the people with their rivers/streams and mainstream them for conservation and restoration. The river-based addresses can be as effective as the current administrative address, if practiced. The people feel more close those belongs to the same administrative areas such as blocks/districts/state, but unfortunately, the people sharing same water and soil don't feel connected. To strengthen the connectivity among sharing the common pool resources, need to strengthen the natural connectivity. The river-based address have the potential to establish connection with the people from same watershed/catchment/sub-basin. Even if we look closely in more detail the rituals, festivals and cropping patterns have more similarity in the same catchment as compared to the administrative blocks, because one block may be divided into more than one catchment but one catchment/sub-basin. Watershed is a natural boundary which having somewhat similar geo-physical conditions. To conserve the resources of this natural unit and to build the resilience against the climate change the unity of the people is important factor. Generating and populating the river-based address can bring this social connect with natural resources. There are many evidences across the world where rivers are either in filthy conditions or completely dry, it's not all because of the resource degradation but also the ignorance of people, and it is not due to the lack of knowledge but the sense of ownership. If we are able to awaken that sense of ownership among communities then they have all the traditional knowledge system to make it sustainable. Until and unless people have ownership on rivers/ecosystems, will not restored.

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Supporting documents:

https://www.civilsdaily.com/drainage-system-part-4/

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