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# Flood control measures: mapping encroachments along the river Kaveri in Tamil Nadu, Thanjavur District, India

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#### ABSTRACT

Problem of encroachments on the river Kaveri area is grave and affects the rural environment of this region during seasonal and flash floods. Like the problem of polluted waters, that of encroachments is quite common with almost all the rivers and streams. The first type of encroachment comes from the builders of houses and other concerns. Due to the steep growth of population in Kaveri delta area, and concentration of more rural villages are being affected. The area on the banks of the Kaveri which generally lies vacant and unused seems to be an ideal place for constructing houses and other encroachment is by the farmers who own lands adjoining to the Kaveri. The greed for more yields and more income at any cost has led the farmers to hunt for more land. For the gross root level study and to use the GPS survey the entire river length (77 km) has been divided into five zones and identified the encroachments.

Key words: Encroachments, GPS, Flash Flood

#### INTRODUCTION

An illegal intrusion in a highway or navigable river, with or without obstruction is encroachments. An encroachment upon a street or highway is a fixture, such as a wall or fence, which illegally intrudes into or invades the highway or encloses a portion of it, diminishing its width or area, but without closing it to public travel. In the law of EASEMENTS, where the owner of an easement alters the dominant tenement so as to impose an additional restriction or burden on the serving tenement, he or she is said to commit an encroachment. Encroachment is "Unlawful entering (gradually and without permission) upon the land, property, other possessions, or the rights of another". For example, a building extending beyond the legal boundaries on to neighboring private or public land, or beyond the building-line of a road or street"[1]. The valley and channels of rivers are shrinking and vacated land is getting available for human settlements, which are mostly unplanned, and therefore, obstructing the original path of rivers leading to high risk of Uttarakhand (2013) and Kashmir (2014) type of rain-led devastation."[2]. Regulation of rivers, and the resulting alteration of flow, threatens ecosystem functions and biodiversity globally [3, 4]. Among many other effects, river regulation can result in the encroachment of terrestrial vegetation into channels [5, 6]. Moreover, the extent of encroachment can increase with greater reductions in flow [7]. Many people have constructed houses on the river course. ERODE: Many farmers and also local bodies are unhappy over the closure of Mettur reservoir for irrigation as water was drawn for drinking purposes too. But a few, however, are happy over the closure as they can easily encroach on the Cauvery River. Harvest After the dam's closure, meagre quantity of water is flowing into the river. This has thrown the field open for encroachers. The encroachers have raised paddy

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and it is likely to be harvested in April. Similar encroachments are also seen in many places. Many people have constructed houses on the river course.

#### PROBLEM STATEMENT

Flood is a major hazard in the delta regions, particularly the Kaveri delta. Seasonal floods induced by the cyclonic disruptions often disturbs the Kaveri delta people, affecting the day to day life, and some time heavy loss to human and properties along the river banks. There are several reasons for flooding; due to torrential seasonal rainfall the delta region is flooded and allows excess water to drain affecting agricultural productivity and leaving several other homeless. Uncontrolled encroachments along the river banks forms yet another reason for flooding; in other words this would narrow the river channels and heavy water is forced to enter the river channels resulting several breaches along the weak portions of the river bund. Due to this factor several small villages along the river bunds are affected during flooding season. To justify this, sample river courses along the river Kaveri, from Kallanai to Tiruvisainallur for distance of 77 kilometers have been taken for the study. The present study would count the number of encroachments along both sides of the river Kaveri and how this has been allowing flood water into the nearby villages affecting many villages to flee their home and loss to agricultural and other properties.

#### **OBJECTIVES**

a. To count the number of encroachments along the 77 kilometer length of Kaveri river from Kallanai to Tiruvisainallur, both sides, using GPS field survey,

b. To assess the types of encroachments and their implications towards the narrowing down of the channel width and heavy flow during seasonal rainfall and damages to the river bunds and subsequent flooding.

### MATERIALS AND METHODS

To count the number of encroachments a base map has been prepared using Indian topographical maps in the scale of 1:50,000 and the following sheets were selected to draw the base map: 58 J/13, 58 N/1, 58 N/5. These three topographical maps were scanned for digital conversion and merged to get a 77 kilometer length of the river Kaveri, from Kallanai to Tiruvisanallur. From the scanned map the river segments alone have been cropped to transfer the encroachment data. Different shape file has been created using the ArcMap. The major part of the work is the field visit and GPS survey of 186 encroachments, which are within the range of 200 feet from the bund (in both directions). For the gross root level study and to use the GPS survey the entire river length (77 km) has been divided into five zones and named from 1 to 5 in the maps. The river jurisdiction covers the taluks of Thiruvaiyaru, Papanasam and Kumbakonam. For the cross verification, the encroachment data has been gathered from the PWD of Thanjavur and according to their basic data the total number of encroachments numbering to 323. But in this study only 186 encroachments were only considered, because of the 200 feet range. In each zone, each and every encroachment well within the range of 200 feet from the bund was surveyed using GPS GS 20. The surveyed data has been overlapped with the digitally converted images of the river course for the five major zones and georeferenced. Different shape files were also created using ArcGIS 9.0. Accordingly, the following are the number of encroachments in each zone: Zone-1: 13; Zone-2: 20; Zone-3: 50; Zone-4: 64; Zone-5: 37; (Total of 186). Five maps for five zones have been devised using ArcMap along with the area of each and every encroachment covered. This field data acquired through the GPS indicate that the presence of encroachments along the 77 km length, as a sample area analysis and the implications during the flood season.

#### STUDY AREA

Thanjavur is located at 10.8° N 79.15° E It has an average elevation of 2 metres (6 feet). The city lies on the south bank of the Kaveri River, 200 miles south of Chennai. The district is located in the centre-east of the state, bounded on the northeast by Nagapattinam District, on the east by Tiruvarur district, on the south by the Palk Strait, on the west by Pudukkottai District, and on the north by the Kollidam River, across which lies Tiruchirappalli and Perambalur districts. The flat northern part of the district includes part of the Kaveri River delta. It is irrigated by an elaborate system of dams, cuts and canals in connection with the Kaveri and its chief distributary the Kollidam these two rivers and the lesser distributaries run from west to east.

#### MAPPING ENCROACHMENTS: FIRST STEP TOWARDS FLOOD CONTROL MEASURE

Just below the grand anicut, and at right angles to it, head regulators have been provided for the Cauvery and the Vennar, which branches off from it. The water from Grand Anicut is diverted to Cauvery River, Vennar river and

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Grand Anicut Canal to irrigate the area of 12.05 lakhs -acres under them. Cauvery and Vennar systems are very old and Grand Anicut Canal is a new one, excavated in 1934. The Cauvery and Vennar divide and sub-divide in to as many as 36 branches whose total length is about 1610 km; these fan out to irrigate the Thanjavur delta. These rivers, for a total length of 5600 km, feed over 1500 main channels; in turn, they supply about 28,000 branch and sub-channels, which have a total length of about 19,000 km. The rivers in the Cauvery and Vennar Sub Basins with a length of about 1610 km, have several branches into numerous channels. The primary uses of Kaveri are providing water for irrigation, water for household consumption and the generation of electricity. An estimate at the time of the first Five Year Plan, put the total flow of the Kaveri at 12 million acre-feet (15 km<sup>3</sup>), of which 60 per cent was used for irrigation.



To study the encroachments along the river bunds, from Kallanai to Tiruvisanallur at a stretch of 77 kilometers have been taken to study the above problem of flooding during heavy rainy seasons and marooning several villages along the rivers. Figure-1 shows the sample Kaveri river bed, which has been divided into five zones and the first consisting of seventeen kilometers and the rest of the four zones consisting of fifteen kilometers to show details of the ecroachments along the river courses. In the figure apart from settlements, agricultural lands and river channels are also shown.

The first zone and the corresponding encroachment table (Table-1) gives the details of encroachments from Kallanai to Agarappettai for a stretch of 17 kms. They include paddy fields, settlements, and farm lands such as coconut, teak, casuarina and banana. The details of area in meter square for the individual categories are shown towards the respective samples.

Types	Total Area m <sup>2</sup>	Total Length m		
Banana Trees	152.24	63.51		
Casuarina	425.66	145.94		
Coconut Trees	184.84	119.57		
Paddy	394.78	167.26		
Settlements	280.25	145.68		
Teak Trees	30.65	28.59		
	Types Banana Trees Casuarina Coconut Trees Paddy Settlements Teak Trees	Types Total Area m <sup>2</sup> Banana Trees 152.24   Casuarina 425.66   Coconut Trees 184.84   Paddy 394.78   Settlements 280.25   Teak Trees 30.65		

Table - 1, Zone1: Encroachments Details Kallanai to Agarappettai

Source: Field Survey using Global Positioning System

Table-2 displays the encroachment details from Tiruchchinnampundi to Achchanur surveyed using GPS. The encroachment details are given in the meter square measurements which include fields such as paddy, betel, sugarcane, white yam, teak, mango, coconut, and banana and bamboo grass apart from unauthorized settlements.

S.No	Types	Total Area m <sup>2</sup>	Total Length m			
1	Bambo Trees	297.84	74.34			
2	Banana Trees	1522.51	462.48			
3	Betel	232.96	65.98			
4	Coconut Trees	23.86	20.14			
5	Mango Trees	380.82	84.46			
6	Paddy	62.86	32.67			
7	Sugarcane	92.06	43.80			
8	Settlements	311.99	190.97			
9	Teak Trees	411.35	147.70			
10	Whiteyam	240.13	75.06			
Sou	Source · Field Survey using Global Positioning System					

Table - 2, Zone2: Encroachments Details Tiruchchinnampundi to Achchanur

Table-3 shows the third zone stretches 15 kms from Valappakudi to Vichitrarajapuram. In this zone, even unauthorized shopping complexes apart from settlements and agricultural activities are present. The details of individual parameters of the encroachments are given in table-3.

S.No	Types	Types Total Area m <sup>2</sup>	
1	Banana Trees	311.81	221.84
2	Betel	300.48	133.74
3	Brick kilns	10.70	26.50
4	Coconut Trees	238.62	220.82
5	Garden	24.69	31.83
6	Mango Trees	356.51	153.48
7	Paddy	321.67	164.00
8	Shopping complex	46.24	29.16
9	Sugarcane	19.08	16.03
10	Teak Trees	99.08	66.81
11	Settlements	495.99	300.13
12	Bambo Cross	297.84	74.34

Table - 3, Zone3: Encroachments Details Valappakudi to Vichitrarajapuram

Source: Field Survey using Global Positioning System.

Figure-2 and table-4 gives the details of zone four for a length of 15 kilometers from Vichitrarajapuram to Swamimalai. As the river proceeds to the nearby urban centers the encroachments are increasing in area and the type such as shopping complexes and settlements apart from the agricultural activities. The details of encroachments and the measurement details are given in table-7. Brickline along the river course poses a major obstacle because the clay from the bunds is taken and the bricks are manufactured. Due to this reason, taking more bund clays reduces the height of bunds and allows the free flow of excess water to the nearby villages during seasonal heavy rainfall.



Fig - 2

Table - 4, Zone4: Encroachments Details Vichitrarajapuram to Swamimalai

S.No	Types	Total Area m <sup>2</sup>	Total Length m		
1	Bambo Trees	116.32	85.45		
2	Betel	20.79	26.11		
3	Betel Nut Trees	6.03	18.48		
4	Banana Trees	336.59	333.26		
5	Brick kilns	38.90	25.93		
6	Coconut Trees	58.91	74.21		
7	Drumstick Trees	11.38	10.28		
8	Garden	4.97	8.94		
9	Gongan Trees	71.99	45.15		
10	Ground Nuts	25.62	23.26		
11	Paddy	14.76	17.33		
12	RS Pathi Trees	2.65	9.10		
13	Shopping Complex	68.51	39.51		
14	Whiteyam	4.07	9.04		
15	Sugarcane	13.73	18.57		
16	Teak	10.40	18.70		
17	Settlements	378.99	277.27		
Source: Field Survey using Global Positioning System.					

Zone five, from Swamimalai to Tiruvisanallur a length of 15 kilometers consisting of encroachments and the details are given in table-5. Mostly the encroachments are in the form of agricultural activities. The details are given in table-5 with area in meter square.

Table – 5 , Zone5: Encroachments Details Swamimalai to Tiruvisanallur

S.No	Types	Total Area m <sup>2</sup>	Total Length m
1	Bambo Trees	36.62	62.16
2	Banana Trees	220.99	217.90
3	Paddy	108.88	53.22
4	Settlements	822.62	503.61
5	Teak Trees	7.54	27.67
6	Turmeric	1.35	4.65
7	Sugarcane	77.82	74.44

Source: Field Survey using Global Positioning System.

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Figure-3 and table-6 shows the entire Kaveri river bed stretches from Kallanai to Tiruvisanallur exclusively surveyed for settlement encroachments for more than 60 houses using GPS. In the map each dot represents the presence of more than 60 unauthorised construction of houses/ permanent and semi permanent.



S. No	Types	Zone 1 Area m <sup>2</sup>	Zone 2 Area m <sup>2</sup>	Zone 3 Area m <sup>2</sup>	Zone 4 Area m <sup>2</sup>	Zone 5 Area m <sup>2</sup>	Total Area m <sup>2</sup>
1	Bambo Trees	-	297.84	297.84	116.32	36.62	748.62
2	Betel	-	232.96	300.48	20.79	-	554.23
3	Betel Nut Trees	-	-	-	6.03	-	6.03
4	Banana Trees	152.24	1522.51	311.81	336.59	220.99	2544.14
5	Brick kilns	-	-	10.70	38.90	-	49.60
6	Coconut Trees	184.84	23.86	238.62	58.91	-	506.23
7	DrumstickTrees	-	-	-	11.38	-	11.38
8	Garden	-	-	24.69	4.97	-	29.66
9	Gongan Trees	-	-	-	71.99	-	71.99
10	Ground Nuts	-	-	-	25.62	-	25.62
11	Paddy	394.78	62.86	321.67	14.76	108.88	902.95
12	RS Pathi Trees	-	-	-	2.65	-	2.65
13	Shoppingcomplex	-	-	46.22	68.51	-	114.73
14	Whiteyam	-	240.13	-	4.07	-	244.20
15	Sugarcane	-	92.06	19.08	13.73	77.82	202.69
16	Teak	30.35	411.35	99.08	10.40	7.54	558.72
17	Settlements	280.25	311.99	495.99	378.99	822.62	2289.84
18	Mango Trees	-	380.82	356.53	-	-	737.35
19	Casuarina	425.66	-	-	-	-	425.66
20	Turmeric	-	_	-	-	1.35	1.35

Table – 6 Encroachments Details Kallanai to Tiruvisanallur

Source: Personal Computation

### CONCLUSION

To manage the floods in Kaveri delta region, the present field study would be of immense help with the information of river encroachments gathered using GPS field survey. This implies that encroachments play a dominant role in

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diverting excess flood water into the small and medium villages located along the banks of the sample river selected for this study. The study also reveal that once these encroachments are removed/ terminated the major floods during monsoon season would reduce/ and there will not be any excess flow to maroon the nearby villages. The report will be helpful for the district administration to take appropriate steps to remove the unauthorized encroachments that affects another part of the society.

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