Mapping Rural Health Systems using GIS

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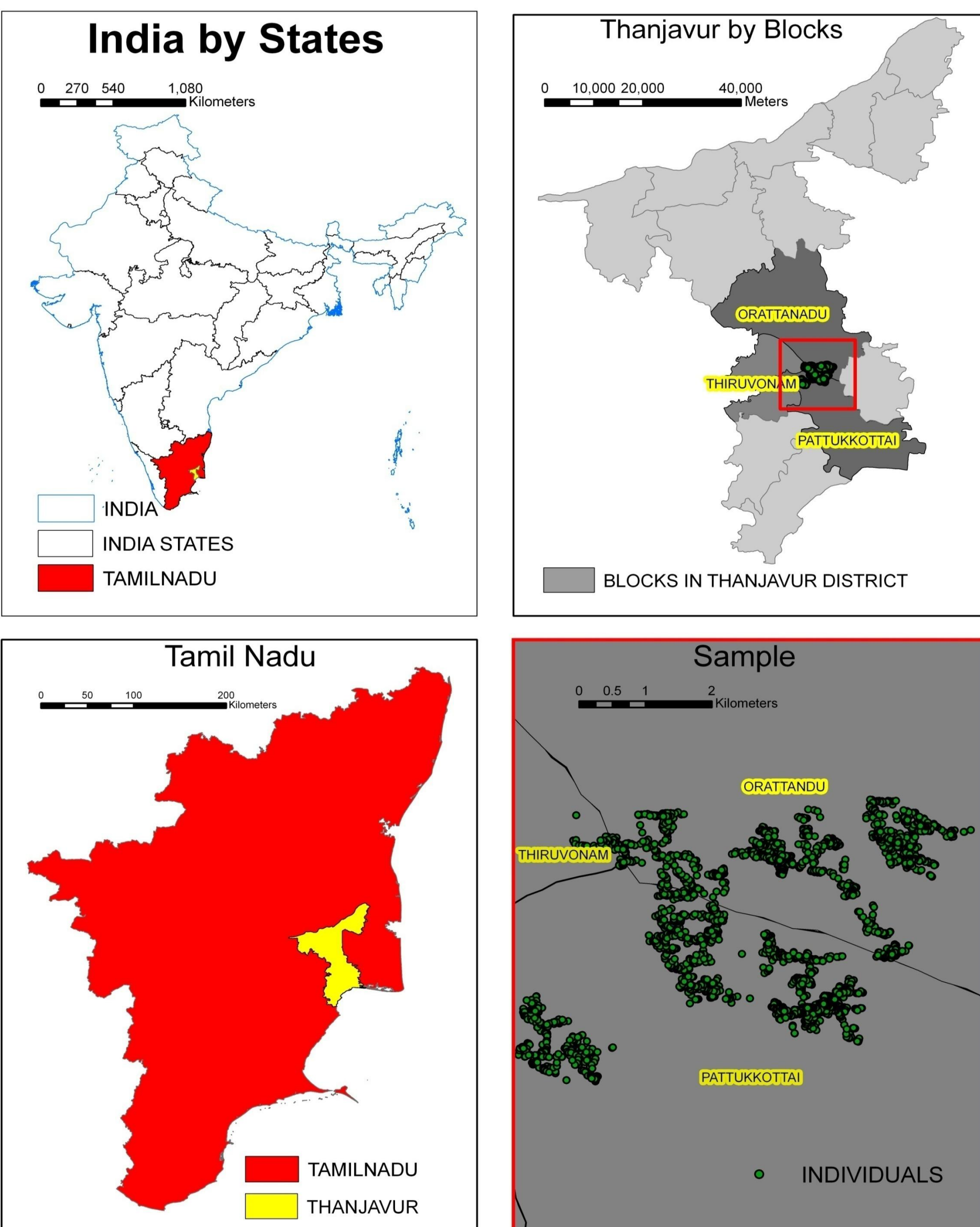Washington University in St. Louis

Faces of Hope

Introduction

IKP Centre for Technologies in Public Health (ICTPH) aims to improve the health of poor populations through an inclusive process that scientifically integrates knowledge of factors influencing health and diseases in India, regular evaluation and impact assessment of existing health systems and integration of appropriate technology for optimal health care delivery. In this context, an Integrated Rural Health System has been designed, developed and implemented by ICTPH in their field sites that spans across 15 villages in rural South India.

The field site used in the current project is located in Thanjavur district of Tamil Nadu state. The district is further classified in to 8 taluks, 14 blocks and several revenue villages. The health system model includes a primary care clinic with health workers called SughaVazhvu Guides (SVG) performing outreach services including preventive and promotive health programs. Each SVG caters to a defined population within a hamlet and 13 such hamlets availing clinical services though direct provision as well as referral from the various SVG's.

Aims & Objectives
•Mapping of the health system model to look at access to outreach and primary care services.
•Analyze the Clustering of population in reference to spatial location of SVG's.
•Map disease incidence and prevalence by hamlets by tracking geotagged households from Electronic Health Record data.

Field site in the context of India

India by States
INDIA
INDIA STATES
TAMILNADU

Thanjavur by Blocks
ORATTANADU
THIRUVONAM
PATTUKKOTTAI
BLOCKS IN THANJAVUR DISTRICT

Tamil Nadu
ORATTANADU
THIRUVONAM
PATTUKKOTTAI
TAMILNADU
THANJAVUR

Sample
ORATTANADU
THIRUVONAM
PATTUKKOTTAI
INDIVIDUALS

Map borders obtained from DIVA-GIS, some map information and data obtained from Centre for Develpment Finance & KGFS.

Methods

Shapefiles collected from various sources were used to draw maps of the blocks and villages. Georeferencing helped in matching the map with official maps released by the Government. Information from ICTPH include
•Patient information and residence coordinates
•Records of clinic visits.
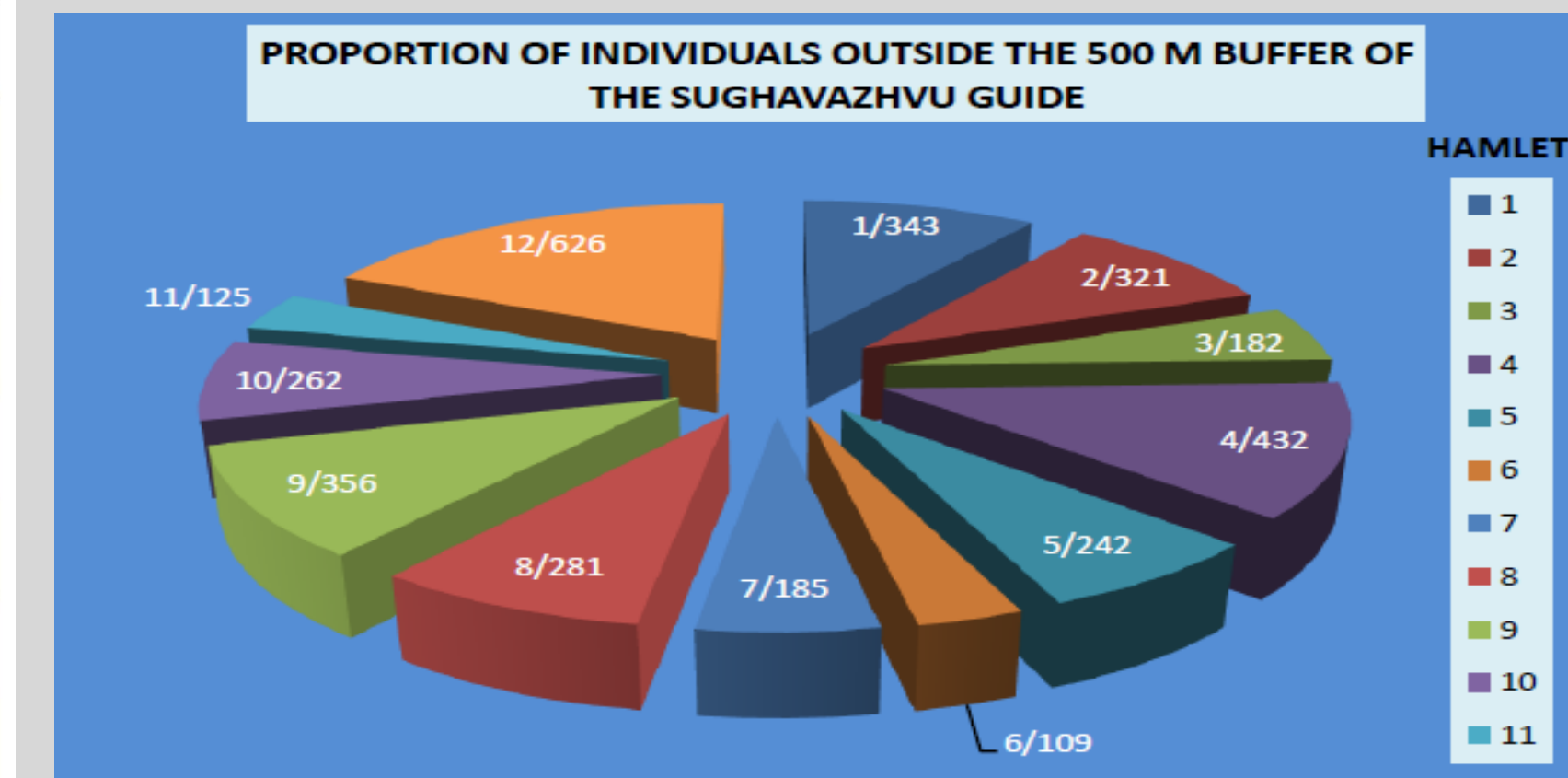•Border Shapefiles for mapping purposes from partner organizations

Using ArcGIS and Google Earth, geotagged individuals and SVGs were inserted into maps. Buffer layers were drawn at various distance around SVG and the clinic to look at access to primary care services. Spatial analysis was used to measure average distance for coverage by SVG per hamlet as well as distance to the clinic from the centroid of the hamlet. T tests were done to look for statistically significant difference in distance between the clinic and the individual SVGs.

Google Earth Image: Spatial Analysis
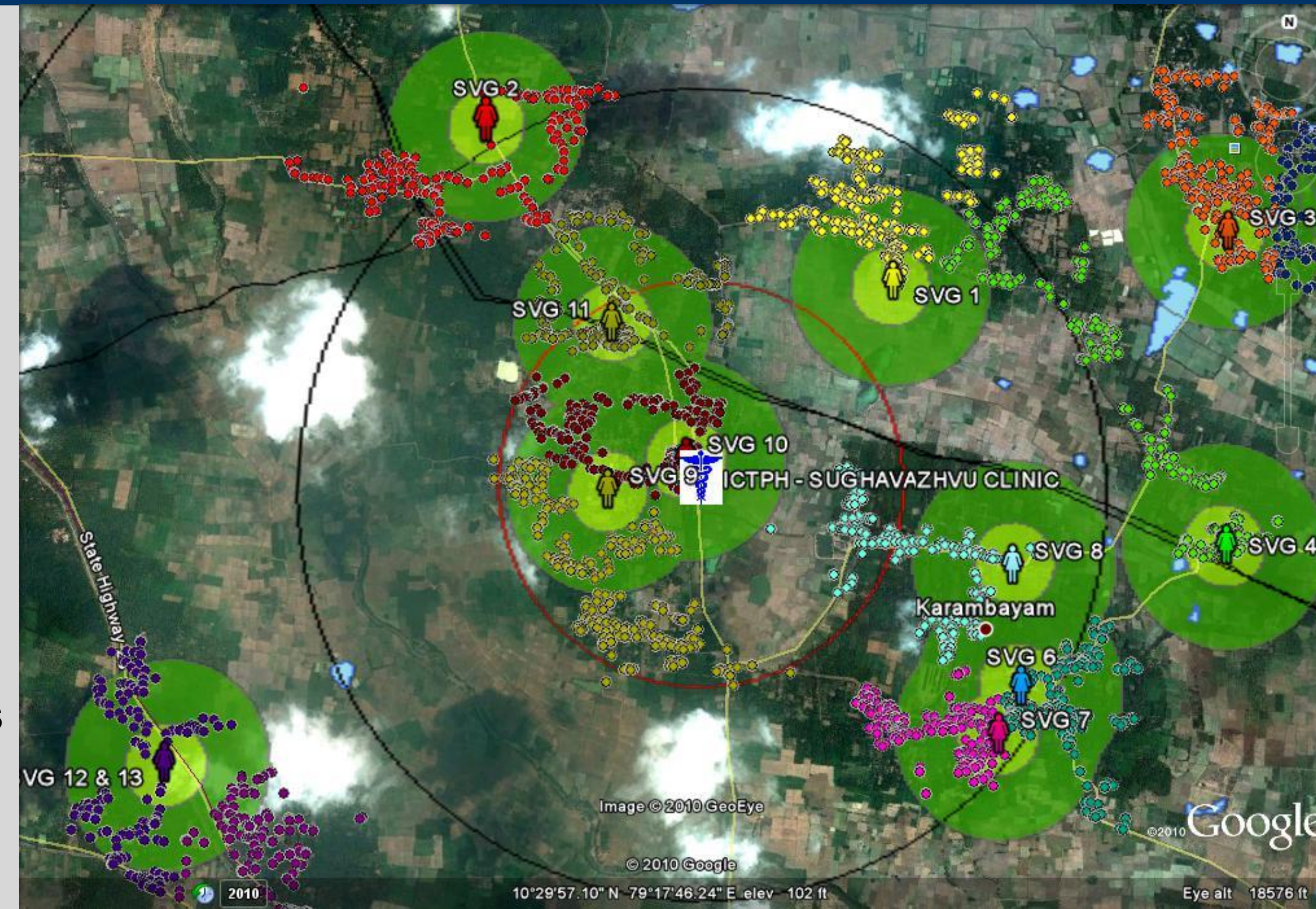
## Analysis

NO.	Village Name	SVG	Members	200 M*	500 M*	> 500 M*	Distance A	Distance B
1	Ambalapattu	Sudha Kamaraj	734	116 [15.80%]	391 [53.27%]	343 [46.73%]	1.38 KM	1085 M
2	Ambalapattu	Saroja	642	19 [2.96%]	321 [50.0%]	321 [50.0%]	2.11 KM	948 M
3	Ambalapattu	Kalaiselvi	648	207 [31.94%]	466 [71.91%]	182 [28.09%]	2.88 KM*	887 M
4	Sembalur	Mary	765	222 [29.02%]	333 [43.53%]	432 [56.47%]	2.58 KM*	2035 M
5	Sembalur	Vijayalakshmi	453	89 [19.65%]	211 [46.57%]	242 [53.42%]	3.79KM **	800 M
6	Etipulikkadu	Pushpavalli	713	297 [41.65%]	604 [84.71%]	109 [15.29%]	1.83 KM	818 M
7	Etipulikkadu	Kaladevi	563	152 [27.0%]	378 [67.14%]	185 [32.86%]	1.85 KM	697 M
8	Karambayam	Uma	634	72 [11.36%]	353 [55.68%]	281 [44.32%]	1.53 KM	1195 M
9	Karambayam	Vanasundari	706	2 [0.28%]	350 [49.58%]	356 [50.42%]	0.47 KM	1256 M
10	Karambayam	Varalakshmi	748	279 [37.30%]	486 [64.97%]	262 [35.03%]	0.115 KM	898 M
11	Karambayam	Ayilrani	584	244 [41.78%]	459 [78.60%]	125 [21.40%]	0.88 KM	630 M
12	Veppankadu	Prema	504+506= 1010.00	78 [7.72%]	384 [38.02%]	626 [61.98%]	2.95 KM*	1034 M
13	Veppankadu	"						

PROPORTION OF INDIVIDUALS OUTSIDE THE 500 M BUFFER OF THE SUGHAVAZHVU GUIDE

HAMLET 1-11

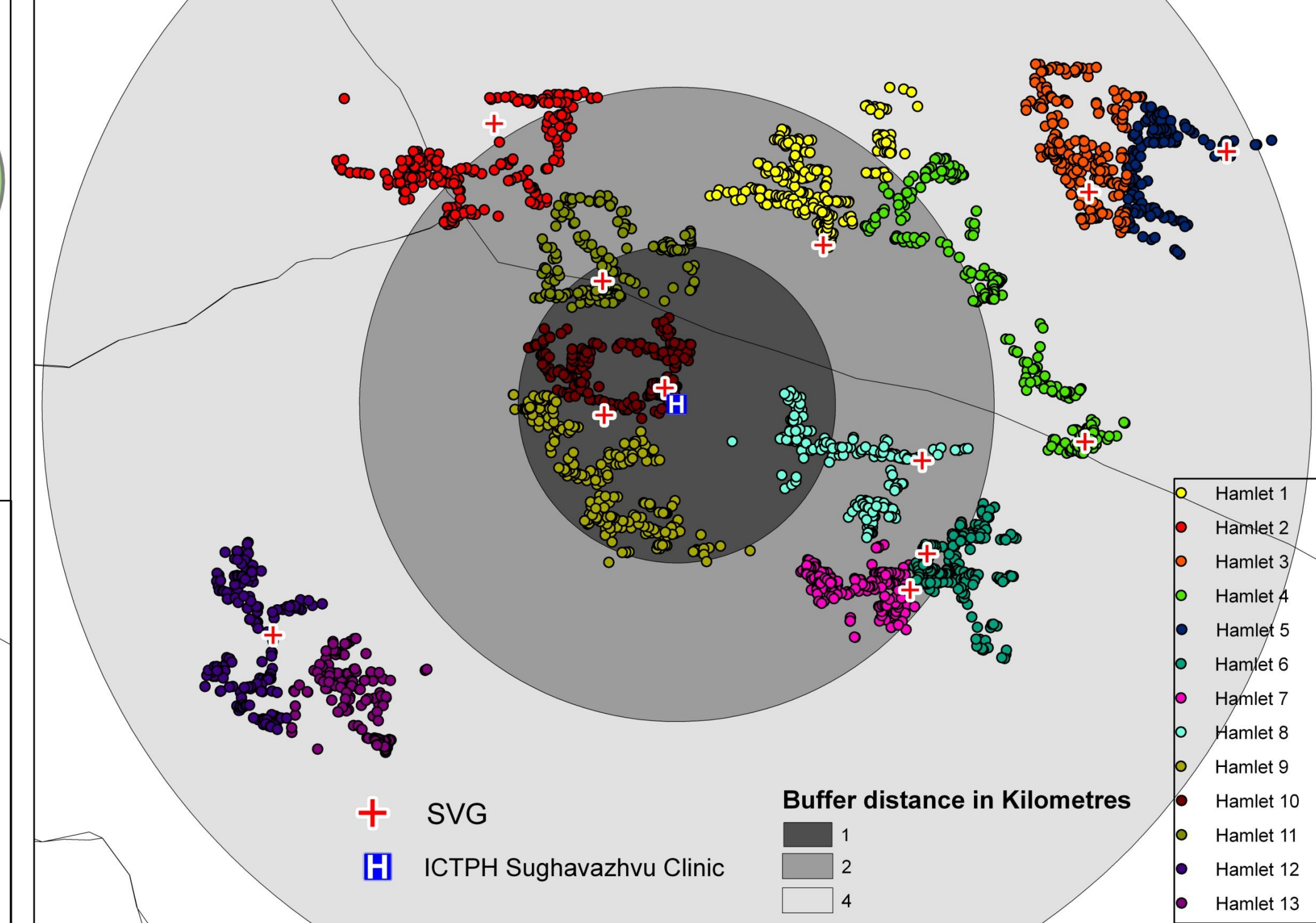12/626, 1/343, 11/125, 2/321, 10/262, 3/182, 9/356, 4/432, 8/281, 5/242, 7/185, 6/109

^The figure above illustrates percentages of residents living more than 500 meters from their assigned SVG guide by hamlet.

<Notes on Table:
•Percentages provided in brackets are a ratio of total hamlet population
•M* = buffer distance around SVG
•500 M* numbers include individuals falling within 200 M* parameters.
•Distance A = distance between SVG of each hamlet and RMHC
•Distance B = distance between SVG and her farthest household.
• * = significant t- test results of p<0.05, p<0.001

Buffers by SVG per Hamlet in Catchment Area

SVG
ICTPH Sughavazhvu Clinic
Bodies of Water

Distance around SVG in metres
200
500

Hamlet 1–13
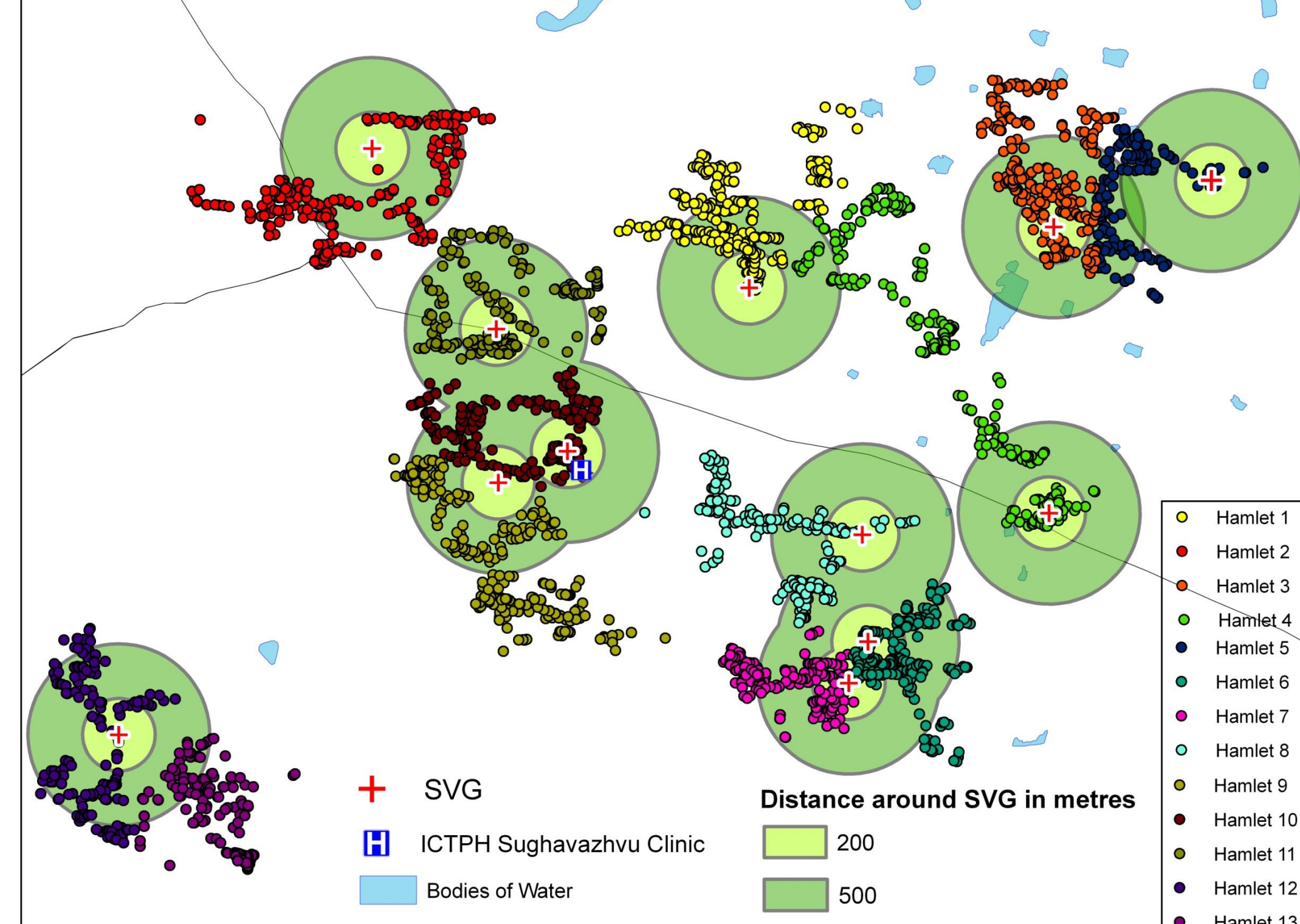
Buffer by distance from ICTPH - Rural Micro Health Centre

SVG
ICTPH Sughavazhvu Clinic

Buffer distance in Kilometres
1
2
4

Hamlet 1–13

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Conclusions

The findings of this mapping exercise helps understand the spatial positioning of the health workers as well as the clinic of ICTPH health systems model. The authors observe a differential access to the SVG for some individuals within the household and access to clinic for some hamlets. Also, a number of hamlets very close to the clinic have the highest proportion of individuals outside the 500 M buffer.

It remains to be seen through further analysis if proximity to the health worker and clinic have any effect on health & disease. Another interesting observation is the application of this map to redistribute some hamlets as we observe that individuals currently being served by a particular SVG are in much closer proximity to another SVG.

Limitations
•Shapefiles that were available for the project did not match with the official maps released by the Government of Tamil Nadu. Shapefiles at the level of the block and taluks were geo-referenced to the official maps.
•Data from the Electronic Health Records have not yet been geotagged to their respective households and hamlets. Once this is available, analysis on hamlet-specific incidence / prevalence and utilization can be spatially displayed.
•As this is a continuing project, further information will be added as data becomes available.

Next Steps

Research
1.Identifying drivers of diseases incidence and prevalence by hamlet using data from the Electronic Health Record.
2. Utilization of primary care services by hamlet.
3.Impact of Rural Health Systems model through spatial analysis.

Evaluation:
Performance evaluation of SVGs by hamlets and by type of condition (communicable / non communicable / injuries)

Empirical Research Questions:
1.Is there a differential improvement in outcome across various buffer layers by the SVG?
2.Is there differential improvement in outcome across buffer layers by the RMHC?

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