ConnectedCities

Global application

The ConnectedCities methodology is applicable to anywhere with a rail system. In the developing countries of Asia, Africa and America it offers a means of accommodating their very fast growth that avoids migration to the already overstretched mega cities, with their urban sprawl, intense high rise living, severe air pollution and often dense slums, where urban infrastructure is often overloaded even before car usage rises to Western levels.

This case study investigates whether instead the ConnectedCities principles can be applied to shift sustainable growth to the more rural areas in which provincial cities are located. It studies India, where currently only 30% of the population live in towns, in comparison with the world average of 50%. With rising expectations and educational levels young people no longer want to stay in the villages. To the challenges are: where should they go; how can their earn enough to support themselves and their families; and what can be done to raise agricultural productivity and incomes?

The example is Tirunelveli in Tamil Nadu, chosen as typical ‘metro city’ (city population ½ to 1.5 million) sited on an existing railway junction.

Tamil Nadu

Tamil Nadu is the southernmost state of India, and has a climate classified as tropical savanna. Its population is 78 million, and the growth rate for the decade before the last census was 16%. The major city is Chennai, whose population expanded by 63% between 2001 and 2011. The rail system has 5,952 km (3,698 mi) of track and 532 railway stations.

Tirunelveli City is located in southern Tamil Nadu, and has a population of 3 million in an area of 6,700 sq.km.

Tirunelveli City has just under 500,000 inhabitants in an area of 150 sq. km. Its population expanded by 15% between 2001 and 2011. At present young people are forced to leave the city and move to the mega cities to find housing and work: hence the dramatic growth in Chennai.

The ConnectedCities methodology identifies Tirunelveli as the hub town of the potential ConnectedCity. Tirunelveli has two stations: Tirunelveli Junction and Tirunelveli Town. The former is much larger than the latter, and the natural Hub.

Rail

Tirunelveli is at the junction of four rail lines, all operated by the Southern Railway Zone. The north–south routes are electrified single track, and the east–west are non electrified single track. In February 2015 Indian Railways sanctioned of the double tracking of the north-south line between Maniyachi-Tirunelveli-Nagercoil, a distance of 170km costing 1.7 billion rupees.

There are seven rail stations within 15 minutes travel time of Tirunelveli Junction:

- Tirunelveli Town - 8 trains per day
- Cheranmadevi - 8 trains per day
- Palayamkottai - 6 trains per day
- Pettai - 4 trains per day
- Sengulam - 1 train per day
- Seydunganallur - 7 trains per day
- Thalaiyuthu - 5 trains per day

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Local Government
Tirunelveli Municipal Corporation is responsible for the City, the two adjoining municipalities of Palayamkottai and Metupalayam, and twelve towns of approximately 20,000 population each.

Road
The Corporation is responsible for 475 miles of roads. Most are single carriageway, but National Highway NH7 to the port town Thoothukudi is dual carriageway. Motorised vehicle ownership for the District in 2011 was 24% of households for two wheelers and 3% for four.

Walking / Cycling / Buses & Rickshaws
One third of commutes to work are on foot. In Tirunelveli District bicycle ownership averaged 46% of households. In 2015, 650 buses were operated by in Tirunelveli District by Tamil Nadu State Corporation and 275 registered to private operators, as well as 250 mini buses. There were 4,000 taxis, 3,000 maxicabs and over 8,500 registered auto rickshaws.

Water & Trees
The average annual rainfall is 880 millimetres. Maximum precipitation occurs during the northeast monsoon in October (166mm) and November (195mm), when extensive flooding occurs. Lowest precipitation is June (16mm) and July (13mm), when water shortages are common. The city water supply is provided by the Tirunelveli City Corporation from the Tamirabarani River. Tamil Nadu Water supply And Drainage Board (TWAD) is responsible for the rest of the District.

Trees have been disappearing from the landscape in recent generations, but local charity SCAD has a programme of planting 100,000 indigenous new trees and sowing about 50,000 seeds per annum. Trees increase green cover and provide fodder and fuels. In turn increasing trees brings more rainfall.

Commerce & Education
Agriculture and food processing are the largest sectors. There are also cement factories, tobacco companies, Tirunelveli is known for its educational institutions, many of which are located at Palayamkottai (east of Tirunelveli) known as the "Oxford of South India". The District has a literacy rate of 77%, which is above the state average. As of 2005–2006, the District had a total of 2,500 schools, one university, four government colleges, eleven government-sponsored and seven private colleges.

Population Growth
The District population growth in the decade 2001 to 2011 was 14%, with rural areas growing at 12% and Tirunelveli City growing at 15%.

The Tirunelveli Local Planning Authority (TLPA) has a master plan to 2021, and within it detailed plans for each area. The plan proposes an expansion of residential areas into the existing agricultural areas on the edge of the city.

In the seven years between 1999-2006 the built up area of the city expanded by about 40 sq.km, while agricultural land declined almost 75 sq.km and water bodies reduced by 21sq.km. Much of the land built upon was previously used to feed the local population.

Smart City
Tirunelveli entered Prime Minister Ghodi’s recent Smart City Challenge, and was ranked 56th nationally. The bid was based on a widespread public consultation including social media, and proposed pedestrianisation around temple area and construction of a Non Motorised Transport corridor to promote walking, as well as new settlement of 250 acres within 10km of the city’s boundaries.
Case Studies

Potential

The aim of the study is to determine if it is possible to accommodate the predicted population in a manner that minimises the loss of agricultural land and need for cars, by developing in well connected locations including sister towns. These will provide new housing and workplaces so that people can live close to their families and food production but still have easy access to the city.

Assuming that growth in the city continues at the same rate as it did between 2001 and 2011 of 15% per decade, the population in 2050 will be 875,000, an increase of 375,000.

Tirunelveli ConnectedCity

Within the pedsheds of the existing stations there is potential for housing and commercial/civic/recreational facilities for 165,000 persons as follows:

<table>
<thead>
<tr>
<th>Existing Station Pedsheds</th>
<th>Existing Pop</th>
<th>Proposed Pop</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tirunelveli Town</td>
<td>15000</td>
<td>30000</td>
<td>15000</td>
</tr>
<tr>
<td>Tirunelveli Junction</td>
<td>15000</td>
<td>30000</td>
<td>15000</td>
</tr>
<tr>
<td>Cheranmadai</td>
<td>10000</td>
<td>30000</td>
<td>20000</td>
</tr>
<tr>
<td>Palayankottai</td>
<td>10000</td>
<td>30000</td>
<td>20000</td>
</tr>
<tr>
<td>Petaa</td>
<td>5000</td>
<td>30000</td>
<td>25000</td>
</tr>
<tr>
<td>Sengulam</td>
<td>2000</td>
<td>30000</td>
<td>28000</td>
</tr>
<tr>
<td>Seyyungamblur</td>
<td>8000</td>
<td>30000</td>
<td>22000</td>
</tr>
<tr>
<td>Thalaiyuthu</td>
<td>9000</td>
<td>30000</td>
<td>21000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>240000</td>
<td>166000</td>
</tr>
</tbody>
</table>

The percentage of anticipated growth to 2050 is 44%.

In addition, possible locations for 8 new stations as shown on the illustration have the potential to accommodate a further 200,000 plus as follows:

<table>
<thead>
<tr>
<th>Proposed Station Pedsheds</th>
<th>Existing Pop</th>
<th>Proposed Pop</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedshed 1</td>
<td>2000</td>
<td>30000</td>
<td>28000</td>
</tr>
<tr>
<td>Pedshed 2</td>
<td>3000</td>
<td>20000</td>
<td>17000</td>
</tr>
<tr>
<td>Pedshed 3</td>
<td>2000</td>
<td>30000</td>
<td>28000</td>
</tr>
<tr>
<td>Pedshed 4</td>
<td>10000</td>
<td>30000</td>
<td>20000</td>
</tr>
<tr>
<td>Pedshed 5</td>
<td>3000</td>
<td>20000</td>
<td>27000</td>
</tr>
<tr>
<td>Pedshed 6</td>
<td>1000</td>
<td>30000</td>
<td>29000</td>
</tr>
<tr>
<td>Pedshed 7</td>
<td>2000</td>
<td>30000</td>
<td>28000</td>
</tr>
<tr>
<td>Pedshed 8</td>
<td>2000</td>
<td>30000</td>
<td>28000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>205000</td>
<td>55</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>371000</td>
<td></td>
</tr>
</tbody>
</table>

99% of predicted growth until 2050 can be accommodated within 1km radius pedsheds of existing and new stations, thereby enabling sustainable growth with minimised increase in carbon footprint and traffic congestion.

In many of the areas where the potential pedsheds are located the three landowners are: Indian Railways, the City or District and private landowners. Pooling the land would enable all parties to participate in the uplift in value, but requires a redistribution of plot ownership. Collectively the land is worth more than in independent units, so all parties emerge from the pooling with assets that are worth more than their initial value and the community also benefits.
Pedsheds

Hub - Tirunelveli Junction
In the area around the Hub at Tirunelveli Junction, medium rise buildings of 5 to 7 or 8 stories would sit in a primarily pedestrianised core. The building heights could be greater if it was felt that tall buildings would enable the city to display itself better as a primary modern centre. In either case creating a new hub to serve the whole ConnectedCity would relieve pressure on redevelopment of the historic city centre.

Tirunelveli Town
The Smart City proposals to preserve and enhanced the best of the traditional city centre can be extended, and create a historic core which retains the charm of previous generations’ contributions to the city, and provides a source of tourist income in addition to general commerce. A pedestrian priority mixed use mall along the present appropriately named Railway Feeder Road will link the temple area to an enhanced station.

Outside the conservation areas redevelopment would be encouraged all in any town growth zone, particularly to the south of the railway. Although this requires loss of good agricultural land, the effects are more than balanced by preserving such land outside the pedsheds which is currently zoned for future development.

Sister Towns
The pedsheds of the current stations serving the well established towns of Cheranmadevi, Palayamkottai, Seydunganallur and Thalayuthu will be developed to preserve each one’s character and direct new growth. Analytes will be undertaken to define existing features to be retained, such as key historic buildings and high yield agricultural land. The remaining areas will be used to provide cores of medium rise mixed use buildings of 4 to 7 stories in which civic, commercial, educational and residential uses will mingle. Beyond, family housing will be in lower rise buildings, probably terraced houses with courtyards. Growth will be restricted to the 1km radius pedshed to ensure access to food producing land is maintained.

The towns of Pettai and Sengulam are currently less developed. The pedshed principles are still applicable, and the mode of development will be in the style of new green quarters.

Infrastructure
Continued electrification and double or quadruple tracking of the railway lines within the ConnectedCity will be required to provide for the additional movement. The upgrading can be financed by capturing the uplift in land value which the new stations and services will bring. The increases in rolling stock needed for frequent or on-demand services will be covered by fares from the additional passengers. The fact that at present there are so few trains provides an opportunity to run much more frequent local services within the limits of the ConnectedCity. Five of the eight proposed new towns are on the less used east-west line.

With the increase in population the road network will have to be upgraded as even with greatly improved railways demand will increase. However, since most new building will be within the pedsheds, major improvements will be primarily to routes that serve them. Outside the pedsheds development along roads will not be permitted to ensure each settlement remains distinct with open land surrounding it.

The strain on the bus services will be eased by the new rail services. Rickshaws can be integrated into the pedestrian priority core of the pedsheds, and serve the outer areas of these medium density settlements more efficiently than cars.

New commerce and educational facilities are located within pedsheds to ensure excellent public transport access and to provide a buffer between rail track and housing.
New Settlements

Development around new stations will follow a similar pattern, but because they are built from scratch it will be easy to ensure a Green Web permeates the whole of these new green towns. The pedshed principles require green wedges between the urban villages to be incorporated in new settlements and created where possible in existing ones.

These wedges can be used to store and move away stormwater. Open cisterns to collect monsoon rains can be surrounded by trees and used to farm fish, which eat mosquito larvae and minimise public health risks.

The experience of both walking and cycling within the pedsheds will be greatly enhanced by trees and protected walkways. These will generate electricity from PV panels for night streetlighting while providing daytime shade from the sun, and in monsoon periods, dry passage.

The typologies of family housing will vary, but generally terraced houses will have sun shaded private courtyards for cooking, and communal courtyards for kitchen gardens, offering the best means of providing suitable densities.

Sanitation for all can be built in from the outset, although it may not be western waterbourne systems due to the water shortages. Instead composting or ‘worm farm’ toilets may be more applicable, as they provide safe fertiliser for local use.

Diagram showing relationship to green wedges between villages can be used for movement and storage of monsoon waters.

Similar diagram showing private communal courtyards within housing blocks. The layout proposed is diagrammatic only. Real life villages will follow the general guidelines but accord with local circumstances, traditions and wishes.

Notional terraced house showing relationship between green wedges and semi-private communal areas to the rear.