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Analysis of the General Hazards and Health Hazards Suffered by the Locals of Kodungaiyur Using Specially Linked Merged Fuzzy Cognitive Maps (SLMFCMs) Model

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Abstract

In this paper we use the Specially Merged Linked Fuzzy Cognitive Maps (SMLFCMs) model to study all problems faced by the Kodungaiyur locals like poverty, ecological imbalance, soil water pollution, problems faced by local rag pickers, literacy rate, health hazards suffered by locals so on.

Key words: Merged graphs, Fuzzy Cognitive Maps, Specially Merged Linked Fuzzy Cognitive Maps (SMLFCMs), Kodungaiyur Dumpyard.

1. Introduction

This paper has three sections. Section one is introductory and describes the problem. Section two uses the Specially Merged Linked Fuzzy Cognitive Maps (SMLFCMs) model to study all problems faced by the Kodungaiyur locals. The final section provides the conclusions of the study[1-7].

All problems faced by the Kodungaiyur locals like poverty, ecological imbalance, soil water pollution, problems faced by local rag pickers, literacy rate, health hazards suffered by locals so on are used as the attributes for analysis.

The set of attributes apart from the air pollution given by the experts are listed below which is described briefly.

D_1 - Ecological disturbances
D_2 - Narrowing of Roads
D_3 - Social Problems (Caste and community of the people living in and around the dump yard)
D_4 - Problems faced by the locals during the rainy season
D_5 - Soil pollution
D_6 - Groundwater pollution due to Leachate
D_7 - Poverty
D_8 - Economic problem
D_9 - Literacy rate

D_{10}- Rag pickers problem
D_{11}- Air and sound pollution due to constant running of trucks
D_{12}- Health hazards faced by locals due to soil and water pollution
D_{13}- Digestive problems
D_{14}- Skin problems suffered by the locals
D_{15}- Government indifference in spite of the protest made by the locals showing their despair
D_{16}- Unemployment problem.

These concepts or nodes are described in a line or two.

D_1 *- Ecological Disturbances*

It is well known that in the 1980's Kodungaiyur was a green stretch of land with migratory birds. Environmental pollution has damaged the Kodungaiyur dump yard beyond repair now functioning as a dustbin of Chennai city[8-17].

D_2 *- Narrowing Roads*

Due to the falling of the garbage from the fast moving trucks with waste the road is narrowed and this narrowing of the road leads to traffic problems in that area.

D_3 *- Social problems*

People living in and around the Kodungaiyur dump yard belong to deprived caste and most backward classes. Caste and community of the people living in Kodungaiyur dump yard is one of the major reasons for government inaction for over 30 years. There is no one belonging to upper caste or backward classes most are only dalits and most backward classes.

D_4 *- Problems faced by locals during the rainy season*

Black water from the dump yard gets into their houses polluting their health and belongings beyond repair.

D_5 *- Soil Pollution*

It can be observed that soil pollution is irreversible as around the dump yard no plants/trees are seen. The surrounding area is bereft of any form of greenery or vegetation.

D_6 *- Ground Water pollution due to Leacahte*

The pollution of the ground water is irreversible, in recent years in Kodungaiyur ground water is available at 5 feet or 10 feet. The water is muddy with the presence of harmful metals and chemicals.

D_7 *- Poverty*

Most of the people living in and around the dump yard are below poverty line. So poverty is one of the reasons for rag picking and tolerance of the locals to the unbearable surroundings.

D_8 *- Economic problems*

Some say due to their improper health they could not be regular in going for the job which affects them economically. Further the place they live is bereft of any economic progress or poshness. Another factor they are vexed about their regular medical expenses. They incur a steady medical expense which only grows day by day. That is why even some non rag pickers to have atleast a meal a day

when they cannot go for job, opt for rag picking[18-24].

D_9 *- Literacy Rate*

The literacy rate is questionably poor. Approximately not even 10% of them will be graduates. Most of them are school dropouts. This answers the question of their ignorance of living in such a polluted area. There is only one corporation school. No colleges or posh schools. With such a poor exposure to education they lead a miserable life. So naturally their economic and social states remain backward.

D_{10} *- Rag Pickers problem*

Being school dropouts with no employment opportunities several people in these 3 decades have become rag pickers. So they have taken up this easy profession to keep them engaged when they needed money. Hence now if the dump yard is shifted or closed down; nearly over 1000 odd rag pickers will face the problem of their livelihood, so only they openly protest for the shift of the waste dump yard from Kodungaiyur.

D_{11} *- Air and noise pollution*

Due to the plying of trucks which carry the waste from several places to the dump yard is constant for every minute a lorry comes to empty the waste, more so in the night, hence the locals suffer not only from air pollution but also from the noise pollution which makes them feel dazed and dizzy.

D_{12} *- Health hazards faced by local due to soil and water pollution*

The locals suffer from constant cold, diarrhea, skin problems, head ache and other untold problems due to water pollution. Headache and hyper tension is also at its peak which may be due to noise and air pollution.

D_{13} *- Digestive disorders*

The locals of Kodungaiyur suffer from several types of digestive disorders due to the pollution of environment.

D_{14} *- Skin Ailments*

All of locals of Kodungaiyur area have a history of skin ailments or they are currently suffering from one or other type of skin ailments.

D_{15} *- The government's indifference*

The government indifference for over 30 years have made them desperate and in some cases aggressive. They feel humiliated for their place is being used as the dustbin of the Chennai city.

D_{16} *- Unemployment*

We see unemployment is one of the drawbacks which has forced them to stay in such a pathetic situation not bothering about their health problems.

2. Use of SMLFCMs model to analyse the above problem :

Now when the experts were asked to work with these attributes they had several choices they want to group the attributes and wanted to work with FCMs. The first expert wishes to work with following nodes using

FCMs.

$B_1 = \{D_3, D_7, D_8, D_9, D_{10}, D_{12}, D_{14}, D_{16}\}$.

Let G_1 be the directed graph given by the first expert using the nodes of the set B_1. The graph G_1 is given in Figure 2.1.

$G_1 =$

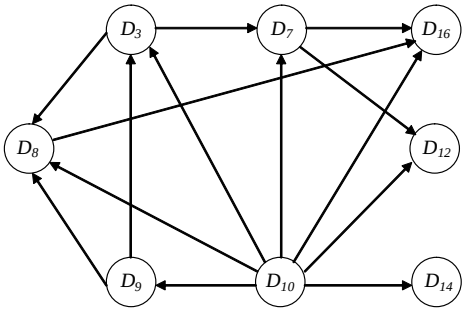

Figure 2.1

Let M_1 be the connection matrix associated with the directed graph G_1.

$$M_1 = \begin{array}{c} \\ D_3 \\ D_7 \\ D_8 \\ D_9 \\ D_{10} \\ D_{12} \\ D_{14} \\ D_{16} \end{array} \begin{array}{c} \begin{array}{cccccccc} D_3 & D_7 & D_8 & D_9 & D_{10} & D_{12} & D_{14} & D_{16} \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}.$$

Now the second expert works with the nodes

$B_2 = \{D_1, D_2, D_5, D_6, D_{11}, D_{12}, D_{15}\}$.

Let G_2 be the directed graph given by the second expert which is as follows:

$G_2 =$

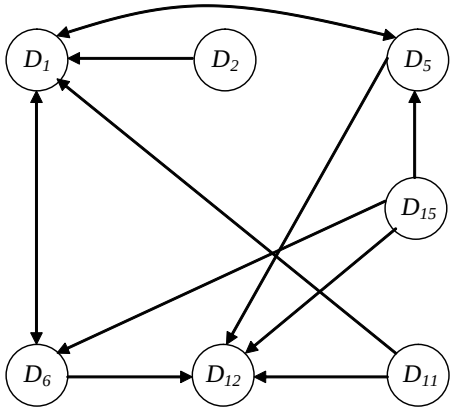

Figure 2.2

The related connection matrix M_2 of the directed graph G_2 given in Figure 2.2 is as follows:

$$M_2 = \begin{array}{c} \\ D_1 \\ D_2 \\ D_5 \\ D_6 \\ D_{11} \\ D_{12} \\ D_{15} \end{array} \begin{array}{c} \begin{array}{ccccccc} D_1 & D_2 & D_5 & D_6 & D_{11} & D_{12} & D_{15} \end{array} \\ \begin{bmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{array}.$$

The third expert wishes to work with the following nodes

$B_3 = \{D_4, D_6, D_5, D_1, D_{13}\}$

Let G_3 be the directed graph associated with the set of nodes in B_3 given by the third expert.

G_3 =

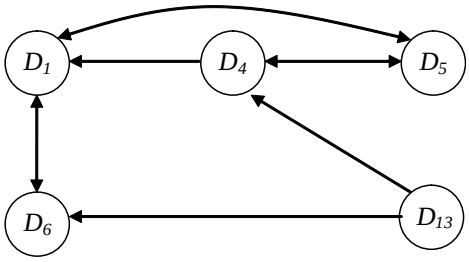

Figure 2.3

Let M_3 be the connection matrix associated with the directed graph G_3 given in Figure 2.3

$$M_3 = \begin{array}{c} \\ D_1 \\ D_4 \\ D_5 \\ D_6 \\ D_{13} \end{array} \begin{array}{c} \begin{array}{ccccc} D_1 & D_4 & D_5 & D_6 & D_{13} \end{array} \\ \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix} \end{array}.$$

Now $B_1 \cap B_2 = D_{12}$, $B_2 \cap B_3 = \{D_1, D_5, D_6\}$ and $B_3 \cap B_1 = \phi$.

The specially linked merged model is as follows. Let G be the specially linked merged graph of the graphs G_1, G_2 and G_3.

G =

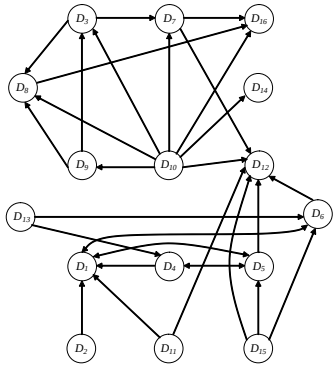

Figure 2.4

Now proceed on to get the specially merged linked matrix N_1 of specially linked merged graph G which is as follows:

$$N_1 = \begin{array}{c} \\ D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \\ D_6 \\ D_7 \\ D_8 \\ D_9 \\ D_{10} \\ D_{11} \\ D_{12} \\ D_{13} \\ D_{14} \\ D_{15} \\ D_{16} \end{array} \begin{array}{c} \begin{array}{cccccccccccccccc} D_1 & D_2 & D_3 & D_4 & D_5 & D_6 & D_7 & D_8 & D_9 & D_{10} & D_{11} & D_{12} & D_{13} & D_{14} & D_{15} & D_{16} \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}.$$

Now using M the hidden patterns suggested by the experts are found. Let X = (1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0) be the initial state vector. To find the effect of X on M.

$XM \rightarrow$(1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0)=Y_1 (say)
$Y_1M \rightarrow$(1 0 0 1 1 1 1 0 0 0 0 1 0 0 0 1)=Y_2 (say)
$Y_2M \rightarrow$(1 0 0 1 1 1 1 0 0 0 0 1 0 0 0 1)=Y_3 (= Y_2 say)

Thus the on state of the ecological disturbances, on the nodes D_4, D_5, D_6, D_7, D_{12} and D_{16} which means problems faced during rainy season, soil pollution, ground water pollution, poverty, health hazards and unemployment[25-30].

The expert considers Z = (0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0) to be the initial state vector.

Find the effect of Z on M.

$ZM = (0\,0\,1\,0\,0\,0\,0\,1\,0\,0\,0\,0\,0\,0\,0\,0)$
$\rightarrow (0\,0\,1\,0\,0\,0\,0\,1\,1\,0\,0\,0\,0\,0\,0\,0) = Z_1$
$Z_1M \rightarrow (0\,0\,1\,1\,0\,0\,1\,0\,0\,0\,0\,0\,0\,0\,0\,1) = Z_2$
$Z_2M \rightarrow (1\,0\,1\,1\,1\,0\,1\,1\,1\,0\,0\,0\,0\,0\,0\,1) = Z_3$
$Z_3M \rightarrow (1\,0\,1\,1\,1\,1\,1\,1\,1\,0\,0\,1\,0\,0\,0\,1) = Z_4$
$Z_4M \rightarrow (1\,0\,1\,1\,1\,1\,1\,1\,1\,0\,0\,1\,0\,0\,0\,1) = Z_5\,(= Z_4)$.

Since $Z_4 = (1\,0\,1\,1\,1\,1\,1\,1\,1\,0\,0\,1\,0\,0\,0\,1)$ is a fixed point.

Thus the hidden pattern of the state of the node literacy rate makes on the nodes D_1, D_3, D_4, D_5, D_6, D_7, D_8, D_{12} and D_{16} which implies the ecological disturbances have taken place to this extent mainly because the literacy rate is poor. For if they are well-educated or educated, they would have certainly prevented this long back; not suffer even after 30 years.

3. Conclusions

Clearly they have social problems for to some extent this can be avoided if they are well educated. They are not fully aware of the health hazards and dangerous when the water from the dump yards floods into their houses in the rainy seasons. This is also attributed to their ignorance which is due to their illiteracy[31-36].

They have without much of education allowed the dump yard to have polluted the soil as it is for a very long period and very large amount of waste dumped in that area. The same reason is attributed for ground water pollution. One of the reasons for their poverty is due to lack of education and constant health problems due to burning of the waste and the stench. They face economic problems mainly due to lack of education. They are ignorant of the health hazards faced by them due to air pollution, soil and water pollution are as they unaware of the seriousness as they lack education. Finally they face unemployment problem as the literacy level of most of them in that area is poor.

References

1. Kosko, B. Fuzzy Cognitive Maps, *Int. J. of Man-Machine Studies, 24,* 65-75 (1986).
2. Kosko, B. Hidden Patterns in Combined and Adaptive Knowledge Networks, Proc. of the First IEEE International Conference on Neural Networks (ICNN-86), *2,* 377-393 (1988).
3. Vasantha Kandasamy, W.B., and M. Ram Kishore. Symptom-Disease Model in Children using FCM, *Ultra Sci., 11,* 318-324 (1999).
4. Vasantha Kandasamy, W.B. and P. Pramod. Parent Children Model using FCM to Study Dropouts in Primary Education, *Ultra Sci., 13,* 174-183 (2000).
5. Vasantha Kandasamy, W.B., and S. Uma. Combined Fuzzy Cognitive Map of Socio-Economic Model, *Appl. Sci. Periodical, 2,* 25-27 (2000).
6. Vasantha Kandasamy, W.B., Florentin Smarandache and K. Kandasamy, Fuzzy and Neutrosophic Analysis of Periyar's Views on Untouchability, Hexis, Arizona, (2005).
7. Vasantha Kandasamy, W.B., and V. Indra. Applications of Fuzzy Cognitive Maps to Determine the Maximum Utility of a Route, *J. of Fuzzy Maths,* publ. by the Int. fuzzy Mat. Inst., *8,* 65-77 (2000).

8. Vasantha Kandasamy W.B. and Smarandache, F., Analysis of Social Aspects of Migrant Labourers Living with HIV/AIDS using Fuzzy Theory and Neutrosophic Cognitive Maps: With Specific Rerefence to Rural Tamilnadu in India, Xiquan, Phoenix, USA, (2004).
9. Vasantha Kandasamy, W.B., and Smarandache, F., Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps, Xiquan, Phoenix, (2005).
10. Vasantha Kandasamy, W.B., Smarandache, F., and Praveen Prakash, A., Mathematical Analysis of the problems faced by the People with Disabilities (PWDs) with specific Reference to Tamil Nadu, Zip Publishing, Ohio, (2012).
11. Vasantha Kandasamy, W.B., Smarandache, F., and Ilanthenral, K., Pesudo lattice graphs and their application to Fuzzy and Neutrosophic models, The Educational Publisher, Ohio, (2014).
12. Zadeh, L. Fuzzy set, *Information and control, 8,* 338-353 (1965).
13. Zimmerman, H.J., Fuzzy Set Theory and its Applications, Kluwer, Boston (1988).

Newsprint / electronic articles

14. Air around Kodungaiyur dump hazardous: Study, (28-10-2012), The New Indian Express, Retrieved from http://www.newindianexpress.com/cities/chennai/article1316580.ece
15. Cement road to be laid at Kodungaiyur dumpyard, (7-2-2013), The Hindu, Retrieved from http://www.thehindu.com/todays-paper/tp-national/tp-tamilnadu/cement-road-to-be-laid-at-kodungaiyur-dumpyard/article4387930.ece
16. Chennai Corporation Government website, http://www.chennaicorporation.gov.in/departments/solid-waste-management/index.htm
17. City to finally be free of garbage dumps, (30-10-2012), The Times of India, Retrieved from http://timesofindia.indiatimes.com/city/chennai/City-to-finally-be-free-of-garbage-dumps/articleshow/17012878.cms
18. Deepa H. Ramakrishnan, "Board to study pollution at Chennai dumping yards", (8-4-2014) The Hindu, Retrieved from http://www.thehindu.com/news/cities/chennai/board-to-study-pollution-at-chennai-dumping-yards/article5884194.ece
19. Dumpyard emissions anger Kodungaiyur, ()11-2-2013), Deccan Chronicle, Retrieved from http://archives.deccanchronicle.com/print/130211/news-current-affairs/article/dumpyard-emissions-anger-kodungaiyur
20. Josephine S.M., Syringes, needles poke their way into Kodungaiyur dumping yard, (8-8-2013) The Hindu, Retrieved from http://www.thehindu.com/news/cities/chennai/syringes-needles-poke-their-way-into-kodungaiyur-dumping-yard/article5000341.ece
21. Kodungaiyur dumping yard to get bigger, (18-11-2012), The Hindu, Retrieved from http://www.thehindu.com/news/cities/chennai/kodungaiyur-dumping-yard-to-get-bigger/article4106412.ece
22. Kodungaiyur Dump-Yard: A Dump on Humanity, (2-8-2013), Retrieved from http://way2sayan.wordpress.com/2013/08/02/kudungaiyur-dump-yard/
23. Lakhoni, R., Solid Waste Management, Chennai Metropolitan Development Authority website.
24. Lakshmi, K. and Manikandan, K., The seeping poison, (14-08-2013), The Hindu, Retrieved from

http://www.sipcotcuddalore.com/News_TheHindu_140813.html
25. Landfills: Impact on Groundwater, Retrieved from http://www.waterencyclopedia.com/La-Mi/Landfills-Impact-on-Groundwater.html
26. Maheshwar, B., Trash Planet: Kodungaiyur (12-09-2012), The Alternative, Retrieved from http://www.thealternative.in/society/trash-planet-kodungaiyur/
27. Monira Shormin, Kodungaiyur dump yard: an obnoxious gold mine, ACJ newsline, Retrieved from http://coveringdeprivation.acjnewsline.org/?p=2577
28. Pallikaranai marsh in Chennai to be transformed into Ecotourism destination (4-1-2014), TracelBiz Monitor, Retrieved from http://www.travelbizmonitor.com/pallikaranai-marsh-in-chennai-to-be-transformed-into-ecotourism-destination-22796
29. Pradeepan Ravi, Solid Waste Management, (6-6-2014), Transparent Chennai, Retrieved from http://www.transparentchennai.com/tag/solid-waste-management/
30. Pramila Krishnan, Hell next door, (13-07-2013), Deccan Chronicle, Retrieved from http://archives.deccanchronicle.com/130713/news-current-affairs/article/hell-next-door
31. Private garbage dump trucks breach – Chennai Corporation loses Rs 1.5 Crores per annum, (11-2-2014), Live Chennai, Retrieved from http://www.livechennai.com/detailnews.asp?newsid=9183
32. R. Sivaraman, Dumping in the dark: Chennai lacks clarity in waste mgmt. policy, (18-09-2013), The Hindu, Retrieved from http://www.thehindu.com/news/cities/chennai/dumping-in-the-dark-chennai-lacks-clarity-in-waste-mgmt-policy/article5138997.ece
33. Report of the sample taken downwind of the Kodungaiyur dumpyard, Retrieved from www.sipcotcuddalore.com/downloads/Kodungaiyur_report_april_2012.pdf
34. Sanjay Pinto, Every breath you take near Kodungaiyur (17-04-2012), NDTV, Retrieved from http://www.ndtv.com/article/south/every-breath-you-take-near-kodungaiyur-198706