

## ISSUES/PROBLEMS PERTAINING TO SINGLE PARENTS- A MATHEMATICAL FUZZY ANALYSIS

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**Abstract:** 'The impact of Family Formation change on the cognitive social and emotional well being of the next generation', says Paul R. Amato. The percentages of children, who live with two parents, have been declining day by day among all racial and ethnic groups. A single parent is a parent with one or more children who is not living with any of the children's other parents. Issues/problems pertaining to the single parents area universal one. Around 25% of the children below 18 years live in a lone parent family. And 90% of lone parents are women. The issues pertaining to single parents are vague and uncertain. And the views about their problems too vary from region to region, time to time and age to age. In this paper, that contains four sections, we are attempting to study the issues pertaining to lone parents from Indian point of view, collecting data from 50 single parents of both the sexes, from Chennai (45 mothers and 5 fathers), TamilNadu. The first section is introductory in nature that summarizes the overall issues pertaining to single parents. Section two gives the basics of Fuzzy cognitive mapping introduced by Bart Kosko(1965) and ably popularized by W.B. Vasantha Kandasamy at all (2000) in analyzing various issues of social importance. In Section three, we list the issues/problems pertaining to the lone parents or single parents or one parent from the responses we get through a questionnaire administered to them and apply Combined Fuzzy Cognitive mapping (CFCM) model to analyze the same. In section four we give the suggestions and conclusion.

**Keywords:** CFCM, Hidden Pattern, Limit Cycle, Fixed Point, Lone Parent/ One Parent / Single Parent.

**Introduction:** According to Relationship Australian. VICTORIA, 'Single parent families are different to families with two parents living under the same roof. There are different reasons why a person becomes a single parent. They may choose this life style, they may have been in a relationship which they left, or perhaps their partner has died or left them. Definition: A single parent is someone who is bringing up a child or children on their own, because the other parent is not living with them defines English Dictionary (1819). 'A person bringing up a child or children without a partner is said to be a single parent according to Oxford English Dictionary. Encyclopedia of children health defines, 'single parent families are families with children under age 16 headed by a parent who is widowed or divorced and not remarried or by a parent who was never married.'

**World Scenario of single parent families:** American Scenario: In U.S according to 2010 censuses 27.6 percent children lived with one parent families. 72.6 percent single parents are mothers, 45 percent of single mothers are currently divorced or separated 1.7 percent are widowed, 34 percent of single mothers never have been married!

**The Scenario in Britain:** Official figures in Britain reveals that the number of single parent families reached the 2 million mark for the first time -almost tripled over the past 40 years. In 1971, just eight percent of households were headed by lone parent, but by 2011 that figure had reached 22 percent. A survey that interviewed 9.7 lakh people, reveal the

fact that the popularity of marriage has fallen as the proportion of single women aged 18 to 49 years who have never married has double, up from just 18 percent in 1979 to 43 percent in 2011. The proportion of the same age who live with a partner, but are not married has tripled from just 11 to 34 percent.

**The scenario in Australia:** One parent families in Australia account for around one-fifth of all families with children under 15 years of age in 1986. In 2003-2004. It was estimated that government pensions and allowances were the principal source of income for 61 percent of one parent families. Many women and some men experiencing sole parenting, often in difficult financial circumstance. In 2004-2006. 22 percent of the children were living in one-parent families. According to family characteristic survey in 2003, 55 percent of lone- parents of children under 15 years are divorced/separated from a registered marriage. A small proportion (5 percent) is widowed. A substantial proportion of one parent, have never married and registered

**Scenario in India:** We find it hard to find statistics of unwed mothers, or single parents or lone parents in India. But one thing is clear that the joint family system has been deteriorating. Joint family system was shielding all that happens between husband and wife. Even if they live separated in body and spirit or in spirit less body, it was the joint family that has been taking care of children born to them.

But of late, we notice frequent divorce, separation, even leading to suicide etc. in Indian families, especially after women started working and earning

on par with men in IT sector. This given rise to problem of degeneration of joint family system, abundaning parents in old age/leaving them in old age homes, separation due to divorce etc.

This article will picture the existing Indian Scenario, by interviewing the single parents in Chennai city, Tamil Nadu.

**2. Fundamental of CFCMs:** In 1965, L.A. Zadeh has introduced a mathematical model called Fuzzy Cognitive Maps. After a decade in the year 1976, Political scientist R. Axelord used this fuzzy model to study decision making in social and political systems. Then B. Kosko enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive map and fuzzy degrees of interrelationships between concepts. FCMs can successfully represent knowledge and human experience, introduced concepts to represent the essential elements and the cause and effect relationships among the concepts to model the behavior of any system. It is a very convenient simple and powerful tool, which is used in numerous fields such as social, economical and medical etc. illustrated by W.B.Vasantha Kandasamy in her book, "Application of Fuzzy Models in Social Sciences". In this paper we recall the notion of Fuzzy Cognitive Maps (FCMs), which was introduced by Bart Kosko in the year 1986. This work is based on expert opinion collected throughout Chennai. The data was collected and assimilated from the people using a linguistic questionnaire and this linguistic responses were transformed into fuzzy data. It is important to note that, while doing fuzzy mathematical models, the fuzzy matrix make take its entries from the interval [-1,1]. Even then, they are known as fuzzy matrices. Therefore, it is understood that Fuzzy tools alone have the capacity to analyze these concepts further substantiating the choice of this method.

**2.1 Preliminaries:**

Fuzzy cognitive maps (FCMs) are more applicable when the data in the first place is an unsupervised one. The FCMs work on the opinion of experts. FCMs model the worlds as a collection of classes and causal relation between classes.

**Definition 2.1.1:** An FCM is a directed graph with concepts like policies, events etc as nodes and causalities as edges. It represents causal relationship between concepts.

**Definition 2.1.2:** When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

**Definition 2.1.3:** FCMs with edge weights or causalities from the set {-1, 0, 1} are simple FCMs.

**Definition 2.1.4:** The edges  $e_{ij}$  take values in the fuzzy causal interval [-1,1].  $e_{ij} = 0$  indicates no causality,  $e_{ij} > 0$  indicates causal increase  $C_j$  increases as  $C_i$  increases (Or  $C_j$  Decreases as  $C_i$  Decreases).  $e_{ij} <$

$0$  indicates causal decrease or negative causality.  $C_j$  decreases as  $C_i$  increases (and or  $C_j$  increases as  $C_i$  decreases). Simple FCMs have edge values in {-1, 0, 1}. Then if causality occurs, it occurs to a maximal positive or negative degree. Simple FCMs provide a quick first approximation to an expert stand or printed causal knowledge. If increase (Or decrease) in one concept leads to increase (or decrease) in another, then we give the value 1. If there exists no relation between the two concepts, the value 0 is given. If increase (or decrease) in one concept decreases (or increases) another, then we gives the value -1. Thus, FCMs are described in this way. Consider the nodes or concepts  $C_1, \dots, C_n$  of the FCM. Suppose the directed graph is drawn using edge weight  $e_{ij} \in \{0, 1, -1\}$ . The matrix  $E$  be defined by  $E = (e_{ij})$ , where the  $e_{ij}$  is the weight of the directed edge  $C_i C_j$ .  $E$  is called the adjacency matrix of the FCM, also known as the connection matrix of the FCM. It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries as zero.

**Definition 2.1.5:** Let  $C_1, C_2, \dots, C_n$  be the nodes of an FCM. Let  $A = (a_1, a_2, \dots, a_n)$ , where  $a_i \in \{0, 1\}$ .  $A$  is called the instantaneous state vector and it denoted the on off position of the node at an instant  $a_i = 0$  if  $a_i$  is off and

$$a_i = 1 \text{ if } a_i \text{ is on, where } i = 1, 2, \dots, n.$$

**Definition 2.1.6:** Let  $C_1, C_2, \dots, C_n$  be the nodes of an FCM. Let  $C_1 C_2, C_2 C_3, \dots, C_i C_j$ , be the edges of the FCM ( $i \neq j$ ). Then, the edges form a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be acyclic if it does not possess any directed cycle.

**Definition 2.1.7:** An FCM with cycles is said to have a feedback.

**Definition 2.1.8:** Where there is a feedback in an FCM, i.e., When the causal relations flow through a cycle in a revolutionary way, The FCM is called a dynamical system.  $\longrightarrow \longrightarrow \longrightarrow$

**Definition 2.1.9:** Let  $C_1 C_2, C_2 C_3, \dots, C_i C_j$ , be a cycle when  $C_i$  is switched on and if the causality flows through the edges of a cycle and if it again causes  $C_i$ , We say that the dynamical system goes round and round. This is true for any node  $C_i$ , for  $i = 1, 2, \dots, n$ . The equilibrium state for this dynamical system is called the hidden pattern.

**Definition 2.1.10:** If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider a FCM with  $C_1, C_2, \dots, C_n$  as nodes. For example let us start the dynamical system by switching on  $C_1$ . Let us assume that the FCM settles down with  $C_1$  and  $C_n$  on, i.e. the state vector remains as  $(1, 0, 0, \dots, 0, 1)$  this state vector  $(1, 0, 0, \dots, 0, 1)$  is called the fixed point.

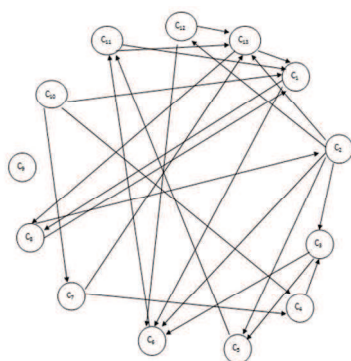
**Definition 2.1.11:** If the FCM settles down with a

state vector repeating in the form  $A_1 \rightarrow A_2 \rightarrow \dots \rightarrow A_n \rightarrow A_1$ . Then this equilibrium is called limit cycle.

**Definition 2.1.12:** Finitenumber of FCMs can be combinedtogether toproducethejointeffectofallthe FCMs. Let  $E_1, E_2, \dots, E_p$  be adjacency matrices of theFCMs withnodes  $C_1, C_2, \dots, C_n$ , then the combinedFCM[5,6,7]isgot by addingalltheadjacency matrices  $E_1, \dots, E_p$ . We denote the combined FCM adjacency matrix by  $E = E_1 + E_2 + \dots + E_p$

**2.1.13: METHOD OF DETERMINING HIDDEN PATTERN:**

Let  $C_1, C_2, \dots, C_n$  be the nodes of an FCM, with feedback. Let  $E$  be the associated adjacency matrix. Let us find the hidden pattern when  $C_6$  is switched on. When an input is given as the vector  $A_1 = (1, 0, 0, \dots, 0)$ , the data should pass through the relation matrix  $E$ . this is done by multiplying  $A_1$  by the matrix  $E$ . Let  $A_1 E = (a_1, \dots, a_n)$  with the threshold operation that is by replacing  $a_i$  by 1 if  $a_i > k$  and  $a_i$  by 0 if  $a_i < k$  ( $k$  is a suitable positive integer). We update the resulting concept. The concept  $C_6$  is included in the updated vector by making the sixth coordinate as 1 in the resulting vector. Suppose  $A_1 E \rightarrow A_2$  then consider  $A_2 E$  and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.



$A = (0100000000000)$   
 $AM \rightarrow (0110110000011) = X_1$   
 $X_1M \rightarrow (1110110100111) = X_2$   
 $X_2M \rightarrow (1110110100111) = X_3 = X_2$   
 Interpretation : When the node  $C_2$  (Stressed due to excess work) is kept in on state in the state vector, we get the nodes  
 $C_1$  (lack of sufficient income)  
 $C_3$  (stresses and traumatized)  
 $C_5$  (hard to cope up with sexual wife)  
 $C_6$  (health problem due to over work & stress)

**3. The analysis of problems of single parents:**

Twenty single mothers were interviewed using a linguistic questionnaire and listed the following inter related issues for analysis using CFCM.

- $C_1$  - Lack of sufficient income.
- $C_2$  - Stressed due to excess work both in office and in the house.
- $C_3$  - Stressed and traumatized when the society around look with suspicion on her fidelity.
- $C_4$  - Unable to answer the queries raised by the child about father
- $C_5$  - Hard to cope up with sexual urge
- $C_6$  - Health problem due to over work & stress
- $C_7$  - Children suffer emotional behaviour problems.
- $C_8$  - Children become independent and hard working.
- $C_9$  - Children involved in decision making unlike the children of dual parents.
- $C_{10}$  - Children behave naughty / disobedient.
- $C_{11}$  - Mother is more strict unlike in normal families
- $C_{12}$  - Mother feels inferiority complex with regard to child care
- $C_{13}$  - Deserted father lives anin disciplined suicidal life.

**3.1 Expert’s opinion from single male parent:** The first expert’s opinion arrived through the responses from malesingle parent.

The related graph  
 The associated matrix is given as

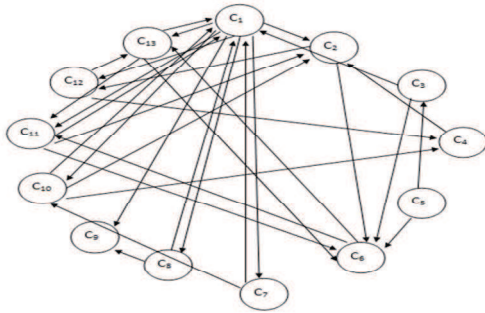
	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_6$	$C_7$	$C_8$	$C_9$	$C_{10}$	$C_{11}$	$C_{12}$	$C_{13}$
$C_1$	0	0	0	0	0	1	0	1	0	0	0	0	0
$C_2$	0	0	1	0	1	1	0	0	0	0	0	1	1
$C_3$	0	0	0	0	1	1	0	0	0	0	0	0	0
$C_4$	0	0	1	0	1	0	0	0	0	0	0	0	0
$C_5$	0	0	0	0	0	0	0	0	0	0	1	0	0
$C_6$	0	0	0	0	0	0	0	0	0	0	1	0	0
$C_7$	0	0	0	1	0	0	0	0	0	0	0	0	1
$C_8$	1	1	0	0	0	0	0	0	0	0	0	0	0
$C_9$	0	0	0	0	0	0	0	0	1	0	0	0	0
$C_{10}$	1	0	0	1	0	0	1	0	0	0	0	0	0
$C_{11}$	1	0	0	0	0	0	0	0	0	0	0	0	1
$C_{12}$	0	0	0	0	1	0	0	0	0	0	0	0	1
$C_{13}$	1	0	0	0	0	0	0	1	0	0	0	0	0

- $C_8$  (Children become independent and hard working)
- $C_{11}$  (mother is more strict)
- $C_{12}$  (mother feels inferiority complex) and
- $C_{13}$  (deserted father lives a suicide life) coming up in ‘on state’, clearly picturising their inter relationship pertaining to the problem of single parent.

**3.2 Expert’s opinion from single female parent:**

The second expert’s opinion arrived through the responses from female single parent.

The related graph is shown below as



The associated matrix is given as

$$P = \begin{pmatrix} C1 & C2 & C3 & C4 & C5 & C6 & C7 & C8 & C9 & C10 & C11 & C12 & C13 \\ C1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 \\ C2 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ C3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C4 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ C5 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ C6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\ C7 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ C8 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ C9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C10 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C11 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ C12 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ C13 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

$$B = (01000000000000)$$

$$PB \rightarrow (0100010000010) = B_1$$

$$B_1P \rightarrow (0101010000011) = B_2$$

$$B_2P \rightarrow (1101010000011) = B_3$$

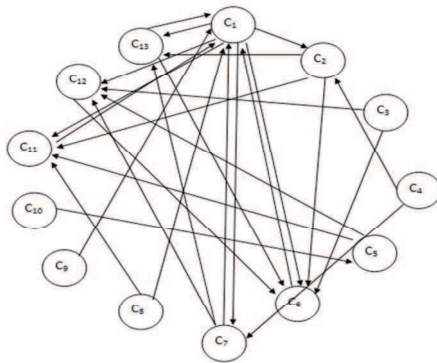
$$B_3P \rightarrow (1101011111111) = B_4$$

$$B_3P \rightarrow (1101011111111) = B_5 = B_4$$

$B_4$  is the fixed point when the node  $C_2$  (Stressed due to excess work both in office and in the house) is kept in on state, in note that all the nodes other than  $C_3$ (stress due to others suspecting her fidelity) and  $C_5$

(sexual urge), come up to on state. clearly indicating the relationship between the attributes, proving the fact that, 'whatever the world feels, you are the justice to what you do'.

**3.3 Expert's opinion from children affected by the cause:** The third expert's opinion arrived through the responses from the children affected by the cause. The related graph is shown below as



The associated matrix is given as

$$Q = \begin{pmatrix} C1 & C2 & C3 & C4 & C5 & C6 & C7 & C8 & C9 & C10 & C11 & C12 & C13 \\ C1 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ C2 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ C3 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ C4 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ C5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ C6 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C7 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ C8 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ C9 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C10 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C11 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C12 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C13 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$T = (01000000000000)$$

$$QT \rightarrow (0100010000010) = T_1$$

$$T_1Q \rightarrow (1100010000010) = T_2$$

$$T_2Q \rightarrow (1100011000011) = T_3$$

$$T_3Q \rightarrow (1100011000011) = T_4 = T_3$$

$T_3$  is the fixed point when the node  $C_2$  (Stressed due to excess work both in office and in the house) is kept in on state, all the nodes,

- $C_1$  (lack of sufficient income)
- $C_6$  (health problem due to over work & stress)
- $C_7$  (Children suffer emotional behaviour problems)
- $C_{11}$  (mother is more strict)
- $C_{12}$  (mother feels inferiority complex)
- $C_{13}$  (deserted father lives a suicide life)

Coming up in 'on state', clearly picturing their inter relationship pertaining to the problem of single parent.

**3.4 Analysis of the problem combining all the three experts' views**

Now we formulate the combined fuzzy cognitive maps using the opinion of three experts.

Let  $S$  denote the combined connection matrix by  $S=M+P+T$

$$S = \begin{pmatrix} C1 & C2 & C3 & C4 & C5 & C6 & C7 & C8 & C9 & C10 & C11 & C12 & C13 \\ C1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C11 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ C13 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$R = (01000000000000)$$

$$SR \rightarrow (0110110000011) = R_1$$

$$R_1 S \longrightarrow (111110100111) = R_2$$

$$R_2 S \longrightarrow (111111111111) = R_3$$

$$R_3 S \longrightarrow (111111111111) = R_4 = R_3$$

**Conclusion and Suggestions :** When the node  $C_2$  (Stressed due to excess work) is kept in on state in the state vector, we get all the nodes  $\{C_1, C_2, \dots, C_{13}\}$  come up on state, clearly indicating the inter relationship among important factors pertaining to the problem of 'single parenting'.

The family is the primary institution that plays a pivotal and vital role in the integrated growth and development of the children, the future generation. Children at the adolescent period onwards should be given life-skill education where the importance of parenthood, the inter relationship between peers, between parents, knowledge on sex and sexualities etc should be provided to avoid the status of one-parent in the life of any body other than that occur due to natural death or death due to

accident, The importance of keeping alive the joint family norms wherever possible should be taught to the growing adults so that the 'old age homes' find a natural exit. Family is the foremost primary Institution that plays a vital role in shaping the personality of the children in a harmonious way. So, parents play a major role where they should live their life as an example for their children to emulate so that there exist no single parent families other than those who lost the other parent by natural death or by accident

**Future Work:** Analyzing the problem using different mathematical Fuzzy Models by collecting data from the whole of Tamil Nadu covering rural, urban and Hill areas.

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