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Simulate Key Factors that Influence Poverty in India using Fuzzy Cognitive Map

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Abstract: ***Poverty is the pronounced deprivation as well as problem of well-being. It does not able to satisfy basic human needs because of insufficient money to buy services or lacks the access to services. Poverty in India is one of the most important social evils and a major determinant of ill health. It is known that poor social status is a major reason of disease and reduces longevity. One of the best ways to improve livelihoods of poor people is that the government has to develop sound policies. So that people below poverty line can improve their livelihoods as well as they can access good jobs, social and infrastructure services. The proposed system critically review the influencing factors which could affect the poverty in India and describe how these factors influence each other using Fuzzy Cognitive Map (FCM) model. This system helps the government to develop sound policies so that people below poverty line can improve their livelihood. By doing so, the poverty evaluation helps to adjudicate financial plan of government and appropriate financial plan of government and poverty alleviation programs significantly decreases the poverty.***

Keywords: Poverty; India; Fuzzy Cognitive Map (FCM); Weight Matrix; Modeling.

I. INTRODUCTION

The Fuzzy Cognitive Maps (FCM) is a useful soft computing technique and it becomes more popular in recent years. Koskos pioneering work on FCMs stands as a milestone in the field [1]. Kosko analyses FCM as fuzzy directional diagrams that clarify feedback. FCMs have concepts as nodes and causalities as links. It represents the nature of the relationship between nodes. Each concept represents a variable, an entity, a characteristic, or a state of the system [2]. The FCMs work on the opinion of experts who supervise, operate, or know the system and its behaviour under various circumstances. The complex causal relationships between factors, characteristics, or components of the system are aggregated from gathered experiences and knowledge. [3]

The main objective of this system is to analyse different key factors that affect the poverty in India and apply a Fuzzy Cognitive Map (FCM) model to evaluate various factors and describe how these factors influence each other. Conceptualizing the poverty in a particular place as well as time and launching programs in consistent with that poverty conception can significantly reduce poverty.

This system helps the government to develop sound policies so that people below poverty line can improve their livelihood. By doing so, the poverty evaluation helps to adjudicate financial plan of the government. The appropriate financial plan of government and poverty alleviation programs significantly decreases the poverty.

II. LITERATURE SURVEY

A. *Poverty In India*

The literature and from the different poverty study it is shown that an individual is considered poor if his spending level per capita is below poverty line. This edge represents the breaking point between poor and non-poor. Poverty is a problematical and complex occurrence, which includes different dimensions of deprivation, for example lack of services and goods, incomes or expenditure of consumption. The evaluation of poverty in India is based on a definition multidimensional of poverty [5].

Poverty in India is the largest and most crucial development defiance. The reduction in the rate of incidence of poverty has been exceedingly slow even though there has been sustained overall economic growth performance since the early 1980s. India has tried periodic assessment of the incidence of poverty from 1950s.

Poverty line is used to estimate poverty and in gathering the information. There have been a number of improvements and changes in the methods for evaluating the poverty lines. The cut-off levels of expenditure have been identified by the consumption expenditure surveys. The households which have expenditure below these cut-off levels, have been classified as being poor [6].

There has been much talk about 'getting to zero' by 2030: extirpate extreme poverty for the first time in human history in the post-2015 discussions. A sharper focus is needed about inequalities that confront those living in chronic poverty. It argues for policies to address the cultural, economic and social forces that block their escape from poverty as well as that pull them back into poverty even if they manage to escape its clutches for a while [7].

B. *Fuzzy Cognitive Map*

Bart Kosko introduced Fuzzy Cognitive Maps in 1986. [1] Aguilar (2005) was the first who tried to collect the FCM applications in various scientific domains till 2004. The number of research papers at 2010 is nearly double of the research papers presented till 2004.

This paper analyzes on an expansive methodology of FCMs and used as a modeling vehicle of time series. In [8] introduced a mechanism in terms of information fragments to represent a numeric time series. These information fragments built by considering the two things, (a) Space of amplitude, (b) Change of amplitude of the time series. This gives a collection of concepts creating the nodes of the FCMs. Every information fragment is mapped onto a node of the map. The two basic design phases of Fuzzy Cognitive Maps are identified and these are, (a) creation of information fragments mapping numeric data (time series) and this data is mapped into activation levels of information granules, (b) escalation of information granules at the parametric level, by estimating the weights between the nodes of the map. The proposed approach is illuminated in detail by experiments using a collection of publicly available data.

In [9] describes a dynamic multi-agent genetic algorithm, which is based on Fuzzy Cognitive Map. This algorithm is used to rebuild large scale GRNs. The thoroughgoing analysis has been done on both synthetic data and benchmark DREAM3 and DREAM4. Results describes that the proposed algorithm can proficiently handle the large search space of reconstructing GRNs. Here FCM is combined with evolutionary algorithms, which is very useful in handling large-scale GRN re-construction problems.

The [10] first improves fuzzy comprehensive evaluation (FCE). The proposed approach is automatic hotel service quality assessment which uses improved FCE. The trustworthy evaluation is done by FCE from a large amount of less trustworthy online comments. Taking casual relationships among evaluation indexes generates FCM and these causal relationships among evaluation indexes are extracted from online comments. The FCM is used, 1) To unfold the problematic areas of hotel service

quality, 2) To improve the service quality by recommending more economical solutions. The proposed approach is useful in evaluating the hotel service quality using online comment. This method is also useful to improve the hotel service quality.

In [11] introduced fuzzy cognitive maps (FCM), which describes the causal influences of antecedent nodes. The particular node is replaced with a weighted mean type operator, which involves an inner product followed by a squashing function. Apply the WPM (weighted power mean) through suitable selection of the weights and exponents in the WPM operators. This new structure of FCM.

III. PROPOSED METHOD

In this paper a new system is proposed, which gives the prediction of the explanatory variables and significance of these variables for explaining poverty in India. The proposed architecture is shown in figure 1, which trying to critically review the influencing factors which could affect the poverty in India and describe how these factors influence each other as well as how they affect poverty line. Here, FCM is used to model various factors, which affect the poverty in India and observed that the explanatory variables are highly significant for explaining poverty in India using FCM output. The Fuzzy Cognitive Map (FCM) Model for poverty in India takes input as raw data of any sub-area as an example.

Data Collection needs the data to be collected from the particular town with minimum population. Then the inputs are in the form of the structure like their education details, per capita income, type of occupation, job, type of family (joint or individual), type of disease they might have contracted, total no of family, whether they are affected by drought or government project like dam, company etc.

This structured input generates the graph for each influencing factor of poverty. The graph shows the analysis of poverty factors that further used as an input concept. These input concepts are used to generate the FCM that describes influencing factors of poverty. The FCM shows the concepts and relationship between them. The edge between the two concepts shows the relationship and this edge has some weight or value. These weights are used to calculate initial weight matrix (W) and apply NHL training method on the FCM with the initial configuration. The values of concepts stabilize after some iteration and get the final matrix (W^{NHL}).

The result is also concept; here result concept is the poverty in that particular area. The final result also shows which poverty factor has what affect and how these poverty factors influence each other. Coefficient calculation gives the final result as explanatory variables of poverty that helps to adjudicate financial plan of government for that particular area. This also helps the government to develop sound policies so that people below poverty line can improve their livelihood. The appropriate financial plan and poverty alleviation programs of government significantly decrease the poverty and it is one of the best ways to improve the living standard of people.

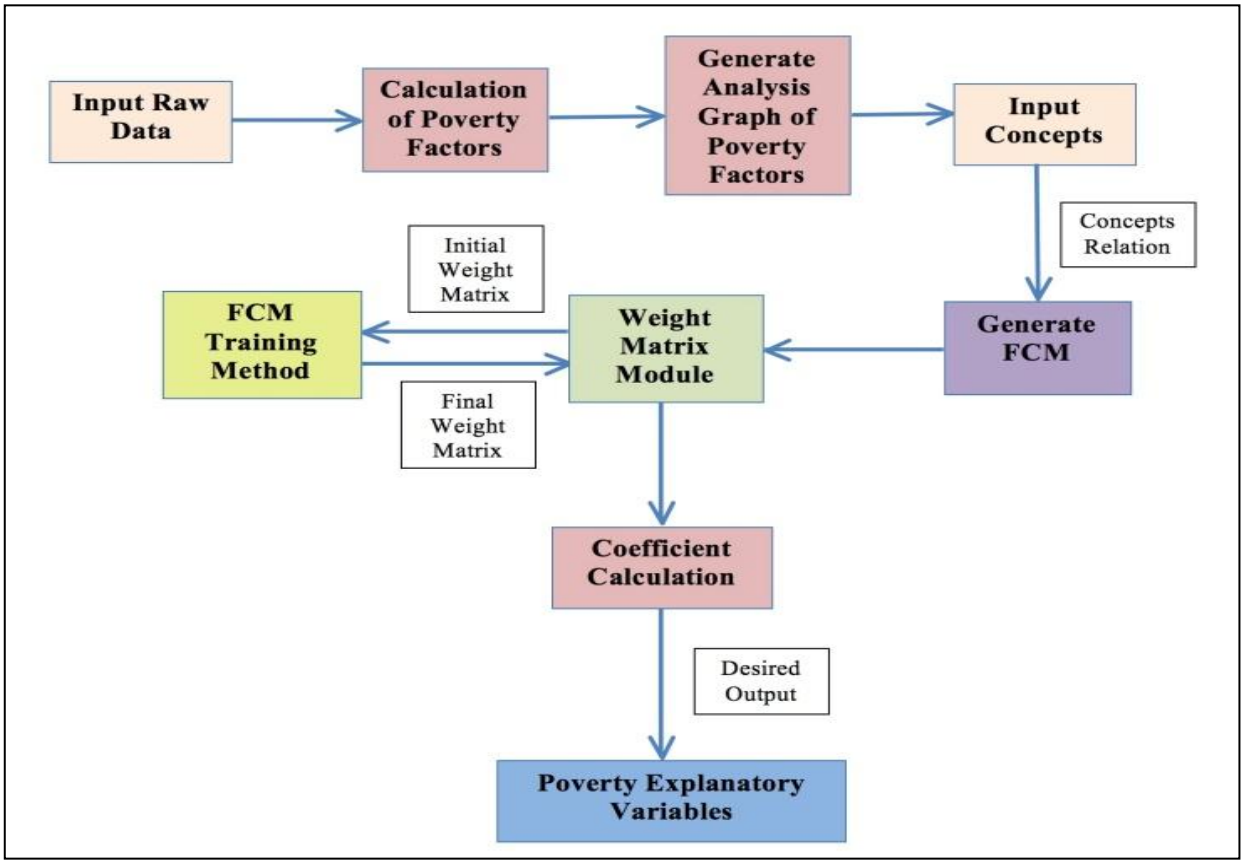

Figure 1. FCM describing poverty factors & their influence

The system flow can be summarized in the following algorithm,

1) Algorithm: FCM model for influencing factors of poverty based on NHL

Step 1: Input raw data of particular town with minimum population;

Step 2: Identify key factors/concepts/issues from all factors, which are resulted from input;

Step 3: Determine casual relationships among these factors/concepts;

Step 4: Determine initial weight matrix from relationships from step 2;

Step 5: Calculate vector A for each iteration according to eq. 1;

Step 6: Update the weight values using NHL rule;

Step 7: These estimates are translated into numeric values in the range [-1,1];

Step 8: If termination criteria met then get final weight matrix, otherwise go to step 3.

The whole proposed system is expressed mathematically in the below model.

2) *Mathematical Model*

Let S = System describing FCM that simulates poverty of respected area

S2 = {C, W, E, G_{FCM}, $W_{0,}$ $W_{NHL,}$ C_{DOC}}

i) Identify input, I = {C, W}

Where C = {C_i| i = 1,....., n}; which is set of concepts or set of influencing factors of poverty

And

$W = \{w_{ij} | i, j = 1,....., n\}$,

Where w_{ij} = Inter-concept casual strengths and n is totality of concepts;

ii) Identify output, $E = \{e_1, e_2, \ldots\ldots, e_m\}$

Where, e = explanatory factors of poverty

iii) Identify Process, $P = \{G_{FCM}, W_0, W_{NHL}, C_{DOC}\}$

Where,

G_{FCM} = Generate FCM,

W_0 = Initial Weight Matrix,

W_{NHL}= FinalWeight Matrix,

C_{DOC} = Coefficient Calculation or Desired Output Concepts.

The value of each concept can be repetitively calculated, according to the following rule,

$$A_i^{t+1} = f\left(A_i^t + \sum_{j=1, j\neq i}^{n} A_j^t w_{ji}\right) (1)$$

Where A_i^{t+1} and A_i^t is the value of concept $C_i$at iteration step t+1and t respectively, W_{ij} is a weight value between the two concepts with direction from concept C_j to concept C_i, and f is a threshold function used to restrict the result into a range [0, 1] or [-1, 1] wherein concepts take values.

IV. Result and Discussion

The proposed system works on the raw data of particular town (any sub-area in India as an example). The comparison between the initial and the resulting matrices shows the influence of the proportion of all poverty factors in that particular area, for example;

Growth of Population:

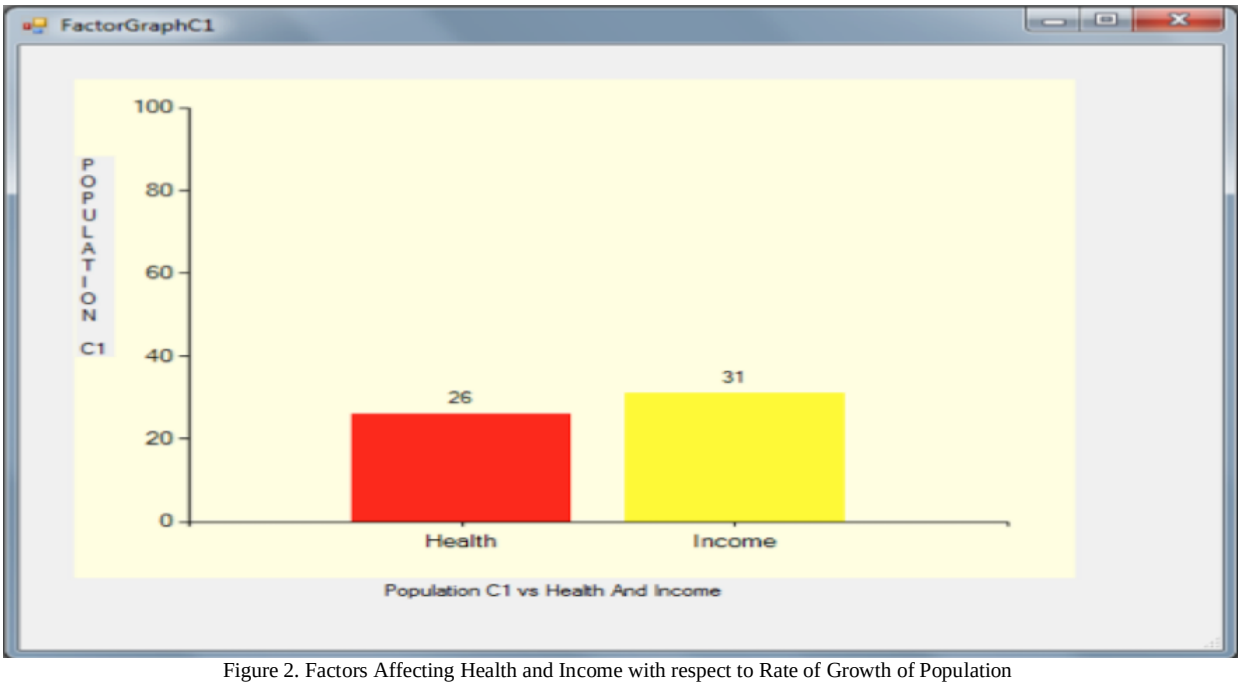

Figure 2. Factors Affecting Health and Income with respect to Rate of Growth of Population

The figure 2 shows the factors affecting health and income with respect to rate of growth of population. Here, the input of 100 individuals is taken and accordingly Health and income is calculated. The figure says that 26% of total population the health is affected with rate of in- crease in growth of population. And also nearly 31% of the people affected of income due to the rise in the growth of population. Where the population growth affects the income source which leads to job scarcity in the town.

Illiteracy:

The figure 3 shows the factors affecting health, population and income with respect to illiteracy. Here 45% of the population is increased with respect to illiteracy, 78% people income is affected due to the illiteracy as there is very less job available and due to which health is also affected around 67%. It affects health, economical condition, population growth and agricultural production.

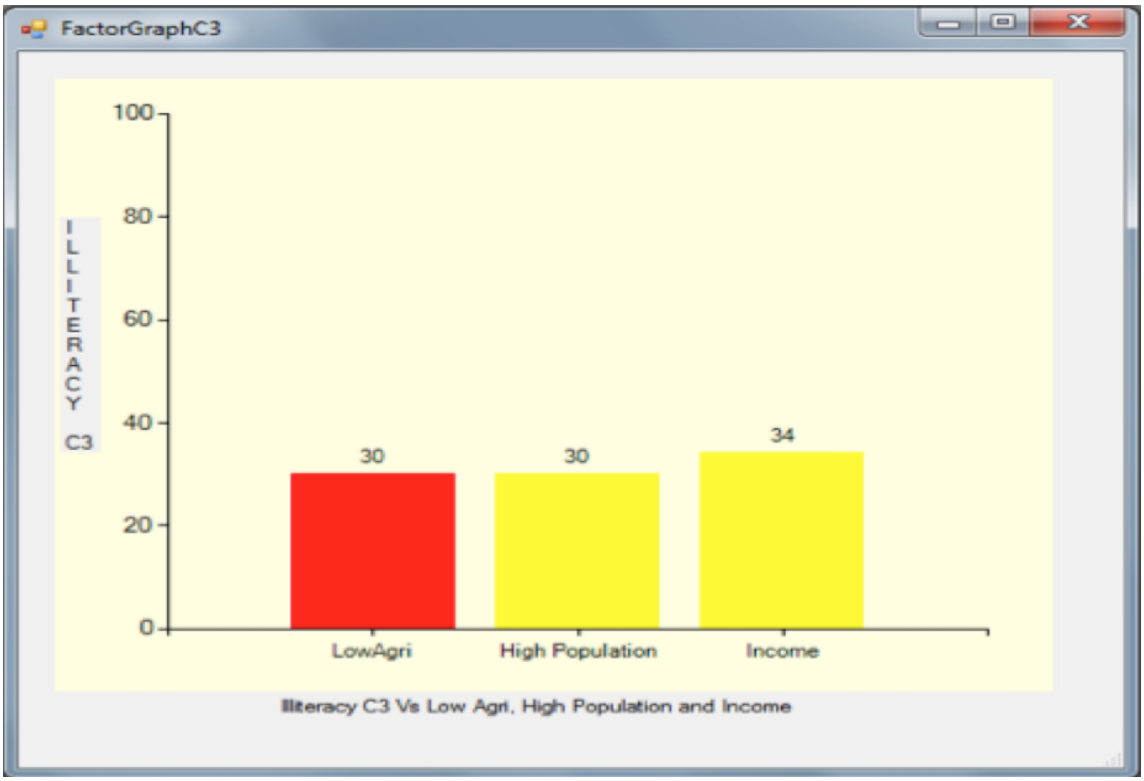

Figure 3. Factors Affecting Health, Population and Income with respect to Illiteracy

So, there is need of schooling, higher education, etc. Government should develop the policies by considering this result regarding illiteracy of that particular area. In this way, analyze all influencing factors of poverty, for example low agricultural production, natural disaster. The final result gives explanatory variables or decision rules of poverty by considering all influencing factors which are included for evaluation in that particular area, as shown in Table 1.

Table 1: Explanatory Variables of Poverty in a particular area

Poverty Factors	**Explanatory Factors.**
Growth of Population	Educate people.
Low Agricultural Production	Agricultural education needed. Awareness of natural calamities.
Low Level of Illiteracy	Door-to-Door Awareness Programs of need for education.
Health	Awareness of hygiene.
Natural Disaster	Awareness of natural calamities.
Income	Entrepreneurship programs. Education.

V. CONCLUSION

In proposed system exhibited an approach that applies poverty evaluation techniques to analyze the different influencing factors of poverty. Technically, conceptualize the relationships between poverty factors in the form of Fuzzy Cognitive Map (FCM) model used to examine the different influencing factors of poverty as well as how they affect each other. Likewise, this system reported and examined a few reasonable results that can be extremely useful for government to decide the financial budget for particular area according to poverty factors influencing that poverty criteria of particular area and it also helps to the researchers.

FCM based poverty evaluation technique give better overview of each poverty factor, which gives very good decision regarding poverty alleviation programs and financial plan of government. This paper provides a new way for evaluating poverty in India at the sub-area or city level.

The Future work will be focused on presenting a system that gives prediction of poverty levels and poverty explanatory variables at state level as well as country level and further work is still required to enhance the overall performance of the system.

The future work also focused on presenting a new FCM learning algorithms and how much the results vary based on different training methods in order to improve the overall precision of FCM parameters.

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References

1. Kosko, “Fuzzy cognitive maps,” Int. J. Man-Mach. Stud., vol. 24, pp. 6575, 1986.
2. J. Dickerson and B. Kosko, “Virtual worlds as fuzzy cognitive maps,” in Fuzzy Engineering, Upper Saddle River, NJ, USA: PrenticeHall, 1997, pp. 125141.
3. B. Kosko, “Neural Networks and Fuzzy Systems,” Englewood Cliffs, NJ, USA: PrenticeHall, 1992.
4. D. Yaman and S. Polat,A fuzzy cognitive map approach for effect-based operations: An illustrative case,” Inf. Sci., vol. 179, pp. 382403, 2009.
5. E. Xhafaj, I. Nurja, “Determination of key factors that influence poverty through econometric models,” European Scientific Journal August 2014 edition, vol.10, No.24 ISSN: 1857-7881 (Print) e - ISSN 1857- 7431.
6. Bhide, Shashanka and Mehta, A. Kapur (2008), “Economic growth and poverty dynamics,” Chronic Poverty Research Centre Working Paper 120 and CPRC-IIPA Working paper No. 36, New Delhi.
7. “The chronic poverty report 2014-2015: The road to zero extreme poverty,” www.chronicpoverty.org.
8. Pedrycz, A. Jastrzebska, W. Homenda, “Design of fuzzy cognitive maps for modeling time series,” IEEE Transactions on Fuzzy Systems, October 2014.
9. J. Liu, Y. Chi and C. Zhu, “A dynamic multi-agent genetic algorithm for gene regulatory network reconstruction based on fuzzy cognitive maps,” IEEE Transactions on Fuzzy Systems, 2015.
10. Xiao Wei, Xiangfeng Luo, Qing Li, Jun Zhang, Zheng Xu , “Online comment-based hotel quality automatic assessment using improved fuzzy comprehensive evaluation and fuzzy cognitive map,” IEEE Transactions on Fuzzy Systems, vol. 23, no. 1, pp. 72-84, February 2015.
11. John T. Rickard, Janet Aisbett, Ronald R. Yager, “A New Fuzzy Cognitive Map Structure Based on the Weighted Power Mean,” IEEE Transactions on Fuzzy Systems, vol. 23, no. 6, pp. 2188-2201, December 2015.

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