IS URBANIZATION A CAUSE OF HEALTH DISASTER: RANKING ANALYSIS BY DECAGONAL FCM

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ABSTRACT

Urbanization, a process of inhabitants concentration from rural to urban areas had greater significant in the livelihood of the populace. Transformations in culture, social relation, social stratification, division of labour are some of the major outbreaks of urbanization. The growth of the developing countries was on par with the growth of the urban areas, but in latter days the bliss of urbanization has began to decline and it rooted the cause for distress amidst the people in various ways. On profound analysis urbanization is becoming the prime cause of various social, communal, economic, political, health problems. In the context of wellbeing the mortality rate of urban natives is high in comparison with the rural, inspite of advancements in the urbanized areas. This kindles the question whether urbanization is the evil cause of health disaster and this has motivated the authors to take up this research work, which mainly aims in ranking the risks of urbanization using fuzzy cognitive maps (FCM) as the tool. The notion of decagonal fuzzy number is used in computation which is a new attempt undertaken by the authors in ranking. The ordering of the risks of urbanization will lay out a clear picture of the real status of urbanization in the developing countries at present times.

Keywords: *Urbanization, Decagonal fuzzy number, fuzzy cognitive maps, ranking, risks, analysis*

I. INTRODUCTION

Health disaster is a kind of disaster that keeps on ameliorating these days. Presently the health conditions of the human beings are getting deteriorated due to various reasons associated with rapid urbanization. Migration of rural people to urban areas takes place for employment and better standard of living, but the increased rate of migration has contributed to hasty urbanization, which has diminished the livelihood of urban residents [1]. The outbreak of new diseases and its swift spread has shattered the life style of the people to greater extent at the same time the emission of pollutants into air, discharge of effluents in water bodies and other contaminants has ruined the environment [2]. In recent times the death toll to dengue, swine flu and other communicable diseases is high in urban regions than in rural, which explicitly picturizes the effects of urbanization. Researchers have highlighted the challenges of urbanization in general but none have made the rankings of it. It is the need of the hour to determine the prime risk of urbanization to plan out suitable measures for mitigating its effects and this research aims the same.

Decision making is not a single step process as it involves logical approaches and systematic tools; one such is fuzzy cognitive maps (FCM). The pioneer of FCM is Kosko [3], who extended the findings of Axlerod [4]. The concept of FCM is very straight forward; it assists the decision makers to find the core causative factor of the problem from other factors considered for study. The factors and its relation are taken as nodes and edges of the graph respectively. Based on the expert's opinion the association between the factors is quantified as 1 if the impact is positive, -1 if negative and 0 if there is no impact. Such representations of weights constitute a simple FCM. If the quantification is between the range -1 to 1, then the FCM is called as weighted FCM. But practically the expert's opinion cannot be limited to numbers; this has given rise to linguistic variable representations, which are quantified by triangular fuzzy numbers [5], trapezoidal fuzzy numbers [6] and hexagonal fuzzy numbers [7] by many scholars. But this research work has made use of decagonal fuzzy numbers, a high grade fuzzy number. This is an inventive effort undertaken for ranking the risks of urbanization.

The paper is structured as follows: section 2 presents the preliminaries; section 3contains the methodology; section 4 ranks the risks of urbanization; section 5 discusses the results and the last section concludes the work.

II. PRELIMINARIES

This section presents the basic definition related to the research work

2.1 Fuzzy Set [5]

A fuzzy set A is a subset of the universal set X is the set of all ordered pair $(x, \mu_A(x))$ where x is an element and $\mu_A(x)$ is the membership value of x, the membership function is defined as $\mu_A: X \rightarrow [0,1]$

2.2 Fuzzy Cognitive Map (FCM) [5]

FCM is an oriented pictorial representation of the association that exists between vertices in terms of arcs.

2.3 Hidden Pattern & Fixed point [5]

The stability state attained by a vector say Ci, i = 1,2…n at time t in a dynamical system is called as hidden pattern and the distinctive state vector is the fixed point .

2.4 Limit Cycle [5]

The FCM settles down with a state vector repeating of the form $A_1 \rightarrow A_2 \rightarrow A_3 \rightarrow \ldots A_i$. A sequence of FCM states keeps repeating indefinitely. This sequence is known as a limit cycle.

2.5 Linguistic Variable [5]

A variable which takes linguistic values rather numeric.

2.6 Decagonal Fuzzy Number [8]

A Decagonal Fuzzy number is defined as (a1, a2, a3, a4, a5,a6, a7, a8, a9, a10) and the membership function is defined as

$$\mu D(x) = \begin{cases} \frac{1}{4}\frac{x-a1}{a2-a1}, & a1 \le x \le a2 \\ \frac{1}{4}+\frac{1}{4}\frac{x-a2}{a3-a2}, & a2 \le x \le a3 \\ \frac{1}{2}+\frac{1}{4}\frac{x-a3}{a4-a3}, & a3 \le x \le a4 \\ \frac{3}{4}+\frac{1}{4}\frac{x-a4}{a5-a4}, & a4 \le x \le a5 \\ 1 & a5 \le x \le a6 \\ 1-\frac{1}{4}\frac{x-a6}{a7-a6}, & a6 \le x \le a7 \\ \frac{3}{4}-\frac{1}{4}\frac{x-a7}{a8-a7}, & a7 \le x \le a8 \\ \frac{1}{2}-\frac{1}{4}\frac{x-a8}{a9-a8}, & a8 \le x \le a9 \\ \frac{1}{4}\frac{a10-x}{a10-a9}, & a9 \le x \le a10 \\ 0 \text{ Otherwise} & \end{cases}$$

The membership function of the decagonal number is presented in the figure 2.1

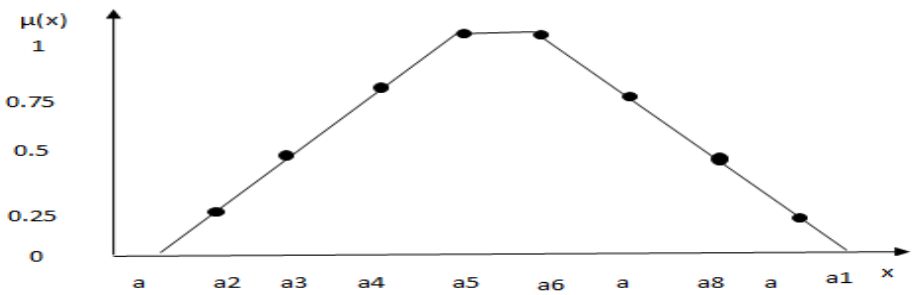

Fig.2.1

III. METHODOLOGY

This section contains the following steps followed used in decision making [5,6]

(1) The attributes pertaining to the problem are considered for study and its influence are expressed as linguistic variables based on the opinion of the experts.

(2) The linguistic connection matrix is then modified to Decagonal Average connection matrix M.

(3) The vector X = (10000..0) (i.e, the first attribute is kept in ON position and others in off position) is passed onto the matrix M. The obtained resultant vector X1 is thresholded by assigning 1 to the maximum value and 0 to others.

(4) The same procedure is repeated for X1 until the state Xi = Xj for some i,j.

IV. RANKING THE RISKS OF URBANIZATION

The following factors are considered for study and the impact of one over the other is represented as follows

DF1 Social volatility

DF2 Socio-economic disparity

DF3 Resource dearth

DF4 Multiplicity of ailments

DF5 Infrastructure disarray

DF6 Outburst of pollutants

DF7 Environmental deprivation

DF8 Residents high rate of occupancy

	DF1	DF2	DF3	DF4	DF5	DF6	DF7	DF8
DF1	0	H	M	L	H	L	L	H
DF2	H	0	H	L	M	L	L	H
DF3	L	M	0	M	M	M	M	M
DF4	L	L	L	0	L	L	L	M
DF5	L	L	L	H	0	M	M	M
DF6	L	L	M	H	M	0	H	L
DF7	L	L	M	H	M	H	0	L
DF8	M	M	M	H	H	H	H	0

Table 4.1 Quantification of Linguistic Variable in terms of Decagonal Fuzzy Number

Linguistic Variable	**Decagonal Fuzzy Representation**	**Crisp Value**
Low (L)	(0,0,0,0.1,0.15,0.2,0.25,0.3,0.35,0.4)	0.175
Medium (M)	(0.2,0.25,0.3,0.35,0.4,0.45,0.5,0.55,0.6,0.65)	0.425
High (H)	(0.6,0.65,0.7,0.75,0.8,0.85,0.9,0.95,1,1)	0.82

The Decagonal Average connection matrix M

	DF1	DF2	DF3	DF4	DF5	DF6	DF7	DF8
DF1	0	0.82	0.425	0.175	0.82	0.175	0.175	0.82
DF2	0.82	0	0.82	0.175	0.425	0.175	0.175	0.82
DF3	0.175	0.425	0	0.425	0.425	0.425	0.425	0.425
DF4	0.175	0.175	0.175	0	0.175	0.175	0.175	0.425
DF5	0.175	0.175	0.175	0.82	0	0.425	0.425	0.425
DF6	0.175	0.175	0.425	0.82	0.425	0	0.82	0.175
DF7	0.175	0.175	0.425	0.82	0.425	0.82	0	0.175
DF8	0.425	0.425	0.425	0.82	0.82	0.82	0.82	0

Let X = (10000000)

X*M = (0 0.82 0.425 0.175 0.82 0.175 0.175 0.82)

→ = (01001001) = X1

X1*M = (1.42 0.6 1.42 1.815 1.245 1.42 1.42 1.245)

→ = (00010000) = X2

X2*M = (0.175 0.175 0.175 0 0.175 0.175 0.175 0.425)

→ = (00000001) = X3

X3*M = (0.425 0.425 0.425 0.82 0.82 0.82 0.82 0)

→ = (00011110) = X4

X4*M = (0.7 0.7 1.2 2.46 1.025 1.42 1.42 1.2)

→ = (00010000) = X5

X2 = X5

Let X = (01000000)

X*M = (0.82 0 1.82 0.175 0.425 0.175 0.175 0.82)

→ = (10100001) = X1

X1*M =(0.6 1.67 0.85 1.42 2.065 1.42 1.42 1.245)

→ = (00001000) = X2

X2*M = (0.175 0.175 0.175 0.82 0 0.425 0.425 0.425)

→ = (00010000) = X3

X3*M = (0.175 0.175 0.175 0 0.175 0.175 0.175 0.425)

→ = (00000001) = X4

X4*M = (0.425 0.425 0.425 0.82 0.82 0.82 0.82 0)

→ = (00011110) = X5

X5*M = (0.7 0.7 1.2 2.46 1.025 1.42 1.42 1.2)

→ = (00010000) = X6

X3 = X6

Let X = (00100000)

X*M = (0.175 0.425 0 0.425 0.425 0.425 0.425 0.425)

→ = (01011111) = X1

X1*M = (1.945 1.125 2.445 3.445 2.27 2.415 2.415 2.02)

→ = (00010000) = X2

X2*M = (0.175 0.175 0.175 0.82 0 0.425 0.425 0.425)

→ = (00010000) = X3

X3*M = (0.175 0.175 0.175 0 0.175 0.175 0.175 0.425)

→ = (00000001) = X4

X4*M = (0.425 0.425 0.425 0.82 0.82 0.82 0.82 0)

→ = (00011110) = X5

X5*M = (0.7 0.7 1.2 2.46 1.025 1.42 1.42 1.2)

→ = (00010000) = X6

X3 = X6

Let X = (00000100)

X*M = (0.175 0.175 0.425 0.82 0.425 0 0.82 0.175)

→ = (00010010) = X1

X1 * M = (0.35 0.35 0.6 0.82 0.6 0.995 0.175 0.6)

→ = (00000100) = X2

Let X = (00000010)

X*M = (0.175 0.175 0.425 0.82 0.425 0.82 0 0.175)

→ = (00010100) = X1

X1*M = (0.35 0.35 0.6 0.82 0.6 0.995 0.175 0.6)

→ = (00000100) = X2

ON Position of the Attributes	**DF1**	**DF2**	**DF3**	**DF4**	**DF5**	**DF6**	**DF7**	**DF8**
(10000000)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
(01000000)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
(00100000)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
(00010000)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
(00001000)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
(00000100)	0.35	0.35	0.6	0.82	0.6	0.995	0.175	0.6

(00000010)	0.35	0.35	0.6	0.82	0.6	0.995	0.175	0.6
(00000001)	0.7	0.7	1.2	2.46	1.025	1.42	1.42	1.2
Aggregate Weight	4.9	4.9	8.4	16.4	7.35	10.51	8.87	8.4
Average	0.6125	0.6125	1.05	2.05	0.92	1.313	1.108	1.05
Rank	6	6	4	1	5	2	3	4

V. RESULTS AND DISCUSSION

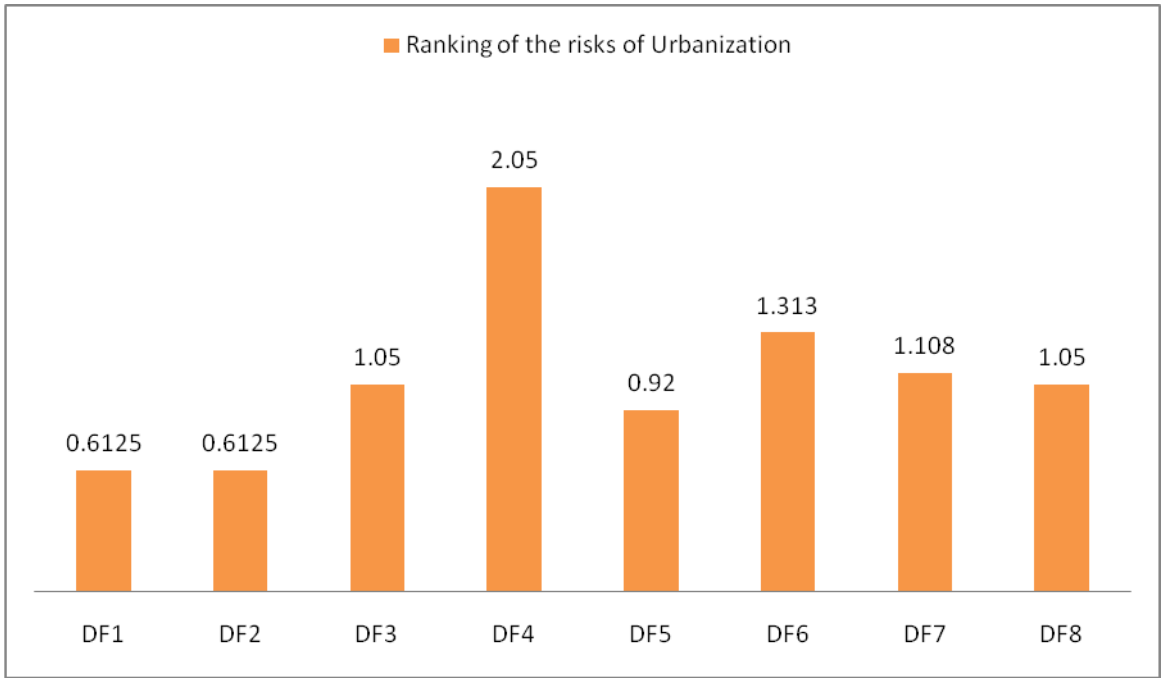

Fig.5.1. Ranking of the risks of Urbanization

The fig 5.1 vividly states that the attribute DF4, multiplicity of ailments is the first risk of urbanization and followed by DF6 & DF7 which are outburst of pollutants and environmental deprivation. The first three risks of rapid urbanization are highly interrelated as it is concerned with the health of the human. It is high time that the government health sectors must take essential steps to prevent the manipulation of the diseases to decrease the mortality rate. The outbreak of several chronic diseases must be controlled and essential preventive measures have to be rendered at right time to avert the situation of chaos. At the same time environmental conservation measures must also be implemented to avoid the disaster of human health.

VI. CONCLUSION

This research work has presented the ranking of the risks of urbanization and it has justified that it is the reason for health disaster. The method of decagonal FCM is an initiative work which encompasses several challenges

of urbanization. This decision making tool assists in determining the prime risks of urbanization in a more systematic manner.

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