



A study on “Pesticide Endosulfan” problem using Neutrosophic Cognitive Maps (NCMs)

N.Narayanamoorthy¹, K.Sivakamasundari² and Smitha.M.V²

¹Bharahiar University, Coimbatore -641046.

²Avinashilingam University for Women, Coimbatore-641043.

ARTICLE INFO

Article history:

Received: 26 May 2013;

Received in revised form:

14 August 2013;

Accepted: 15 August 2013;

Keywords

FCMs,
NCMs,
Pesticide Endosulfan,
Human beings.

ABSTRACT

In this paper we use a tool called Neutrosophic Cognitive Maps (NCMs) defined by W.B.Vasantha Kandaswamy and Florentine Smarandache in the year 2003. In this paper we study to identify the cause of using Endosulfan in agriculture using NCMs which leads to most dangerous side effects in human beings faced by the peoples of South Indian state of Kerala (Kasargod and Palakkad Dt.). A detailed report on the harmful effects faced by the people with the usage of pesticide in India was telecasted in Star T.V. dated June 24, 2012 “SatyamevaJayathe” anchored by film star Amir Khan.

© 2013 Elixir All rights reserved

Introduction

NCMs are a generalization of Fuzzy Cognitive Maps (FCMs). When the data under analysis has indeterminate concepts we are not in a position to give it a mathematical expression. Because of the recent introduction of neutrosophic logic by Florentine Smarandache this problem has a solution. Thus we have introduced the additional notion of Neutrosophy in place of Fuzzy theory. The notion of neutrosophic logic created by Florentine Smarandache which is an extension / combination of the fuzzy logic in which indeterminacy is included. It has become very essential that the notion of neutrosophic logic play a vital role in several of the real world problems like law, medicine, industry, finance, IT, stocks and share etc. Use of neutrosophic notions will be illustrated/ applied in the later sections of this chapter. Fuzzy theory only measures the grade of membership or the non-existence of a membership in the revolutionary way but fuzzy theory has failed to attribute the concept when the relations between notions or nodes or concepts in problems are indeterminate. In fact one can say the inclusion of the concept of indeterminate situation with fuzzy concepts will form the neutrosophic logic.

Endosulfan is an organochlorine pesticide used primarily to kill insects and mites on crops including tea, coffee, cotton, fruits, vegetables. But Endosulfan is acutely toxic and is readily absorbed by the stomach and lungs, and through skin. Symptoms of acute endosulfan exposure include central nervous system disorders such as dizziness, vomiting, diarrhoea, breathing difficulties, convulsions and loss of consciousness. In extreme cases, death can result.

The purpose of the study is to identify the cause of using endosulfan in agriculture which leads to most dangerous side effects. Usage of endosulfan is most likely to occur when the need for food production increases. Prevention of usage of endosulfan depends on the effects of Govt. and local citizen organizations to the preventive and proactive measures. Moreover the data is an unsupervised one and also there is

uncertainty and indeterminacy in the concepts. Hence Neutrosophic tool alone has the capacity to analyse these concepts. Hence it is chosen here.

Definition 1.1: Neutrosophic Cognitive Map is the generalization of Fuzzy Cognitive Map. A Neutrosophic Cognitive Map (NCM) is a neutrosophic directed graph with concepts like policies, events etc. as nodes and causalities or indeterminates as edges. It represents the causal relationship between concepts.

Definition 1.2: NCMs with edge weight from $\{-1, 0, 1, I\}$ are called simple NCMs.

Definition 1.3: Let C_1, C_2, \dots, C_n be nodes of a NCM. Let the neutrosophic matrix $N(E)$ be defined as $N(E) = (e_{ij})$ where e_{ij} is the weight of the directed edge $C_i C_j$, where $e_{ij} \in \{0, 1, -1, I\}$. $N(E)$ is called the neutrosophic adjacency matrix of the NCM.

Definition 1.4: Let C_1, C_2, \dots, C_n be the nodes of the NCM. Let $A = (a_1, a_2, \dots, a_n)$ where $a_i \in \{0, 1, I\}$. A is called the instantaneous state neutrosophic vector and it denotes the on, off, indeterminate state position of the node at an instant

$a_i = 0$ if a_i is off (no effect)

$a_i = 1$ if a_i is on (has effect)

$a_i = I$ if a_i is indeterminate (effect cannot be determined), for $i = 1, 2, \dots, n$.

Definition 1.5: Let C_1, C_2, \dots, C_n be the nodes of the FCM. Let $C_1 C_2, C_2 C_3, \dots, C_{n-1} C_n$ be the directed edges of the NCM. Then the edges form a directed cycle. An NCM is said to be cyclic if it possesses a directed cycle. An NCM is said to be acyclic if it does not possess any directed cycle.

Definition 1.6: An NCM with cycles is said to have a feedback. When there is a feedback in the NCM i.e. when the causal relations flow through a cycle in a revolutionary manner, the NCM is called a dynamical system.

Definition 1.7: Let $C_1 C_2, C_2 C_3, \dots, C_{n-1} C_n$ be the directed cycle, when C_i is switched on and if the causality flow 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 1.8: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider the NCM 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 NCM settles down with C_1 and C_n on, i.e. the state vector remain as $(1, 0, \dots, 0, 1)$. This neutrosophic state vector $(1, 0, \dots, 0, 1)$ is called the fixed point.

Definition 1.9: If the NCM settles with a neutrosophic state vector repeating in the form

$A_1 \rightarrow A_2 \rightarrow \dots \rightarrow A_i \rightarrow A_1$, then this equilibrium is called a limit cycle of the NCM.

Definition 1.10: Let P be the problem under investigation. Suppose let $\{C_1, C_2, \dots, C_n\}$ be n concepts associated with P (n very large). Now divide the number of concepts $\{C_1, C_2, \dots, C_n\}$ into classes S_1, \dots, S_t where the classes are such that

- (1) $S_i \cap S_{i+1} = \emptyset$ where $(i = 1, 2, \dots, t-1)$
- (2) $\cup S_i = \{C_1, C_2, \dots, C_n\}$
- (3) $|S_i| \neq |S_j|$ if $i \neq j$ in general.

Now we obtain the NCM associated with each of the classes S_1, \dots, S_t . We determine the relational matrix associated with each S_i . Using these matrices we obtain a $n \times n$ matrix. This $n \times n$ matrix is the matrix associated with the Combined Overlap Block NCM (COBNM) of blocks of same sizes.

Definition 1.11 Finite number of NCMs can be combined together to produce the joint effect of all NCMs. If $N(E_1), N(E_2), \dots, N(E_p)$ be the neutrosophic adjacency matrices of a NCM with nodes C_1, C_2, \dots, C_n then the combined NCM is got by adding all the neutrosophic adjacency matrices $N(E_1), \dots, N(E_p)$. We denote the combined NCMs adjacency neutrosophic matrix by $N(E) = N(E_1) + N(E_2) + \dots + N(E_p)$.

“Problem definition and Justification for using NCMs Model”

Endosulfan is a polychlorinated hydrocarbon pesticide used in agriculture. Endosulfan introduced in 1950s, it emerged as a leading chemical used against a broad spectrum of insects and mites in agriculture and allied sectors. Endosulfan was introduced at a time when environmental awareness and knowledge about the environmental fate and toxicology of such chemicals were low and not mandatory as per national laws. But now it is being detected as an important cause of pesticide poisoning in many countries. It has been identified with a range of chronic effects including cancer, cerebral meningitis, skin diseases, vision loss and mental disorders and infertility of women. Endosulfan is widely considered to be a Persistent Organic Pollutant (POP) but was not included in the initial list targeted for phase out under the Stockholm Convention.

The purpose of the study is to identify the cause of using endosulfan in agriculture which leads to most dangerous side effects. Usage of endosulfan is most likely to occur when the need for food production increases. Prevention of usage of endosulfan depends on the effects of Govt. and local citizen organizations to the preventive and proactive measures. Moreover the data is an unsupervised one and also there is uncertainty and indeterminacy in the concepts. Hence Neutrosophic tool alone has the capacity to analyse these concepts. Hence it is chosen here.

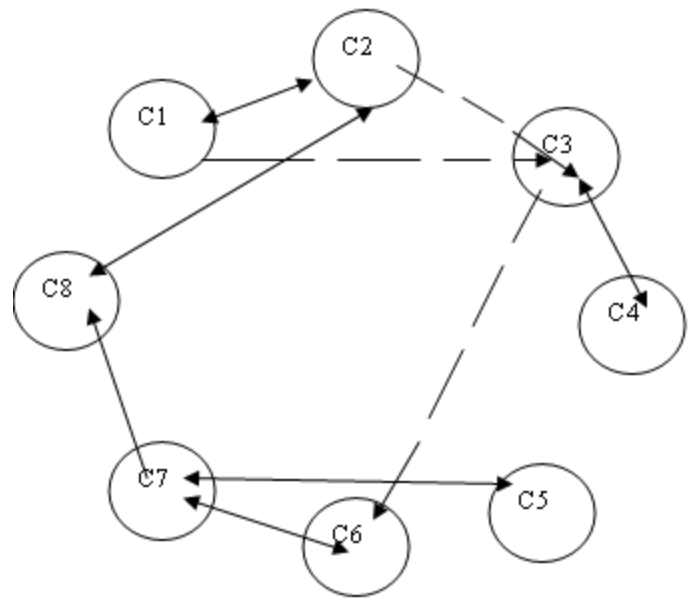
Adaption of NCMs to the problem

Using the linguistic questionnaire and the experts opinion we have taken the following eight concepts $\{C_1, C_2, \dots, C_8\}$.

The following concepts are taken as the main nodes for our problem.

- C_1 – Population increases
- C_2 – Increase of food productivity
- C_3 – Need for pest control
- C_4 – Availability of Endosulfan easily
- C_5 – No awareness of the effect of Endosulfan
- C_6 – No knowledge on alternatives to Endosulfan
- C_7 – Govt. indifference to the owners of farms for using Endosulfan.
- C_8 – No strict punishment from the Govt side for the usage of Endosulfan in farms.

Now we give the neutrosophic graph with C_1, C_2, \dots, C_8 as nodes and also the neutrosophic directed graph with the same nodes.



	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
C_1	0	1	1	0	0	0	0	0
C_2	1	0	1	0	0	0	1	1
C_3	0	0	0	1	0	0	0	0
C_4	0	1	1	0	0	1	0	0
C_5	0	0	0	0	0	1	0	0
C_6	0	0	0	1	1	0	1	0
C_7	0	0	0	0	0	1	0	1
C_8	0	1	0	0	0	0	0	0

$= A$

Now using the matrix A of the Neutrosophic Cognitive Maps we determined the hidden pattern.

Suppose the concept C_3 is ON state and all the nodes are in the OFF state. Let the input vector be $X = (0 \ 0 \ 1 \ 0 \ 0 \ 0 \ 0 \ 0)$. Illiteracy is ON state and all the other nodes in the OFF state.

The effect of X on the dynamic system A is given by

$$XA = (0 \ 0 \ 0 \ 1 \ 0 \ 0 \ 0 \ 0) = X_1$$

$$X_1A = (0 \ 1 \ 1 \ 0 \ 0 \ 1 \ 0 \ 0) = X_2$$

$$X_2A = (0 \ 1 \ 0 \ 2 \ 1 \ 0 \ 1+1 \ 1) \leftrightarrow (1 \ 1 \ 0 \ 1 \ 1 \ 0 \ 1 \ 1) = X_3$$

$$X_3A = (1 \ 1+1 \ 1^2+1 \ 0 \ 0 \ 3 \ 1+1 \ 1+1) \leftrightarrow (1 \ 1 \ 1 \ 0 \ 0 \ 1 \ 1 \ 1) = X_4$$

$$X_4A = (1 \ 1+1 \ 1^2+1 \ 2 \ 2 \ 1 \ 2 \ 2) \leftrightarrow (1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1) = X_5$$

$$X_5A = (1 \ 2+1 \ 2I+1 \ 2 \ 1 \ 3 \ 2 \ 2) \leftrightarrow (1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1) = X_6 = X_5,$$

a fixed point. (where \leftrightarrow denotes the resultant vector after thresholding and updating), X_5 is a hidden pattern which is a fixed point.

Conclusion

While analyzing NCM, when the concept C_3 is ON state, the other concept $C_1, C_2, C_4, C_5, C_6, C_7, C_8$ are in ON state. That is, due to illiteracy people are unaware about the effects of Endosulfan. So that farmers never get a knowledge to think about alternative to Endosulfan. Also due to Govt. negligence, noninvolvement of Govt/social organizations, no strict punishment for using Endosulfan and cheap cost, farmers will get Endosulfan easily. When people are educated they are aware about the side effects of Endosulfan. So that we can avoid the different types of diseases. So Illiteracy is one of the major reason for became victims of Endosulfan. Similarly we can work with other nodes ON state find out the result.

In vegetable cultivation many fields trials have been carried out on alternative pest control methods focusing on herbal pesticides. In some studies, botanical pesticides were found more effective than endosulfan in controlling greenhouse pests. In Asian region farmers have developed their own combinations and methods of pest control using chillies, garlic, asafetida, cow urine and many other plant materials. Many cashew farmers have tried organic method and application of neem oil. Alternative pesticides and organic farming are encouraged in tea plantations and the use of endosulfan is being eliminated.

Sadly, [1] awareness about non pesticide management is negligible in our country. Subsidies to be implemented on organic farming and use of insecticides need to be stopped on an immediate basis. There is anyways enough stress and other kinds of pollution that is harming us. We don't want our foods to be harmful as well. Let us all raise a voice!

Reference

- [1] Amir Khan "Satyamev Jayathe": Toxic food poison on our plate? (Episode 8) June 24, 2012.
- [2] Anon, "ENDOSULFAN" A Fact Sheet and Answers to Common Question. Pesticide News No.60 *the Journal of Pesticide Action Network UK. Quarterly* (2003)P19
- [3] EJF "End of the road for Endosulfan". A call for action against a dangerous pesticide. Environmental Justice Foundation, London, UK. (2002)
- [4] Jian Ying Zhang, Zhi-Qiang Liu, and Sanming Zhou Quotient FCMs. A Decomposition Theory for Fuzzy Cognitive Maps IEEE Transactions on fuzzy systems, VOL. 11 NO. 5, OCTOBER (2003)
- [5] Kosko, B., January, "Fuzzy Cognitive Maps", *International journal of man-machine studies*, pp.62-75 (1986).
- [6] George J. Klir / Bo Yuan, "Fuzzy sets and Fuzzy logic : Theory and Applications" Prentice Hall of India.
- [6] Savy Soumya Misra, "State of Endosulfan". Published Smarandache Florentin on Down To Earth. <http://www.downtoearth.org.in>. December (2010).
- [7] Vasantha Kandasamy and (2003) "Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps". Xiquan, Phoenix
- [8] Vasantha Kandasamy and Smarandache Florentin, (2004) "Analysis of social aspects of migrant labourers living with HIV/AIDS using Fuzzy Theory and Neutrosophic Cognitive Maps", Xiquan, Phoenix.