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TO STUDY THE PROBLEM OF PESTICIDE ENDOSULFAN USING COMBINED OVERLAP BLOCK FUZZY COGNITIVE MAPS

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ABSTRACT

In this paper we use a fuzzy tool called Overlap Block Fuzzy Cognitive Maps (OFCMs) and Combined Block Fuzzy Cognitive Maps (COFCMs) defined by W.B. Vasantha Kandaswamy to study the Endosulfan problems. The Combined Overlap Block FCMs was first defined in 2003. This tool becomes handy when the number of attributes can be grouped and are large in numbers. In this paper we study to identify the cause of using Edosulfan [1] in agriculture which leads to most dangerous side effects in human beings at Kasargod and Palakkad Districts in Kerala. This paper has four sections. In the first section we recall the notion of Fuzzy Cognitive Maps and Combined Block Fuzzy Cognitive Maps (CBFCMS). In section two description of Combined Overlap Block FCMs.. In section three we give the adaptation of Overlap FCM to the problem. Final section gives the conclusion based on our study.

***Keywords*:** *CBFCMS, FCMs, Pesticide Endosulfan.*

1. INTRODUCTION

In this section we just recall that the notion of fuzzy cognitive maps and overlap fcm.A fuzzy cognitive map (FCM) is a fuzzy digraph withfeedback [2], [3] that describes the causal relationships between concepts [4]. There are three kinds of elements in an FCM, namely the concepts, the causal relationships between concepts and the effects one concept influences another concept. These elements are represented by vertices, directed arcs and numerical values (called weights) associated with the arcs, respectively. Each vertex has a state. Most papers in the literature consider the two-state cases where the state of a vertex is either 1 or 0, corresponding to active or inactive respectively. The weight of a directed arc measures the strength of the effect of the initial vertex on the terminal vertex of the arc. This effect is valid only when the initial vertex is active. In other words, if the initial vertex is inactive at some time, it is thought to have no effect on the terminal vertex, even though such an effect is very strong when the initial vertex is active. The state space of an FCM is determined initially by an initial condition and then propagated automatically through the vertex function relative to a threshold until a static pattern is reached. A causal inference is achieved when the FCM reaches a stable limit cycle or fixed point [4], [5]. Recently, the theory of FCM has found many applications in politics, economics, medicine, military, social relation and information system.

Definition 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 1.2: When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition 1.3: FCMs with edge weights or causalities from the set {–1, 0, 1}, are called simple FCMs.

Definition 1.4: Consider the nodes or concepts C1, … , Cn of the FCM. Suppose the directed graph is drawn using edge weight eij $\in$ {0, 1, –1}. The matrix E be defined by E = (eij), where eij is the weight of the directed edge CiCj. 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.

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Definition 1.5: Let C1, C_2, Cn be the nodes of an FCM. A = (a_1, a_2… an), where eij $\in$ {0,1}. A is called the instantaneous state vector and it denotes the on-off position of the node at an instant.

ai = 0 if ai is off

= 1 if ai is on, where i = 1, 2,… n.

Definition 1.6: Let C1, C2, … , Cn be the nodes of an FCM. Let $C_1 C_2$, $C_2 C_3$,… ,$C_i C_j$ be the edges of the FCM ($i \neq j$). Then, the edges form a directed cycle. An FCM issaid 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 1.7: An FCM with cycles is said to have a feedback.

Definition 1.8: When 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.

Definition 1.9: Let $C_1 C_2$, $C_2 C_3$, …, C $_i$ C_j be a cycle. When Ci is switched on and if the causality flows through the edges of a cycle and if it again causes Ci, we say that the dynamical system goes round and round. This is true for any node Ci, for i = 1, 2, … , n. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 1.10: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point.

Definition 1.11: Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let E1, E2, …, Ep be adjacency matrices of the FCMs with nodes C1, C2, …, Cn, then the combined FCM is got by adding all the adjacency matrices E1, …, Ep. We denote the combined FCM adjacency matrix by E = E1 + E2 + … + Ep.

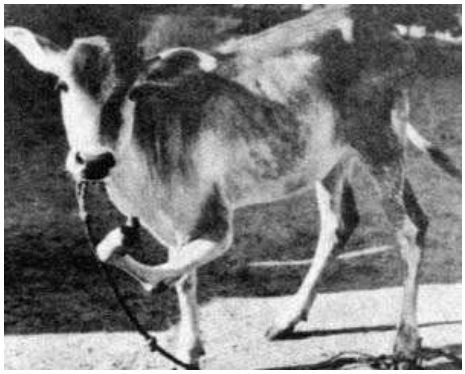
Definition 1.12: Let P be the problem under investigation suppose let {a_1, a_2, ..., a_n} be n attributes associated with P (n very lage) Now divide the number of attributes {a_1,..., an **}** into classes C_1,...,Ct where the classes are such that
(1) $S_i \cap Si+1 \neq \varphi$ where (i = 1, 2,..., t-1)
(2) U Si = {C_1 , , Cn}
(3) |Si| ≠ |Sj| if $i \neq j$ in general.

Now we obtain the FCM associated with each of the classes S1, … , . St. We determine the relational matrix associated with each Si., Using these matrices we obtain a n × n matrix. This n × n matrix is the matrix associated with the Combined Overlap Block FCM (COBFCM) of blocks of same sizes.

II. "**Problem definition and Justification for using Overlap Block FCM Model**"

Endosulfan is a pesticide which is a leading chemical used against a broad spectrum of Insects and mites in agricultural. It has been identified with a range of chonic effects including cancer, cerebral meningitis, birth deformities, skin diseases, vision loss and mental disorders and infertility of women.

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 so no other statistical tool can be applied and only fuzzy tool alone has the capacity to analyze the structure and this fuzzy tool is choosen here.



Endosulfan affected child and a cow [6], [2]

III. Adaptation of Overlap Block FCM to the problem

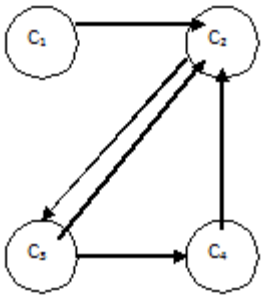
Using the linguistic questionnaire and the experts opinion, [7], [8] we have taken the following seven concepts (C_1, C_2.... C_{10}). The following concepts are taken as the main nodes for our problem.

C_1 – Population increases
C_2 – Increase of food productivity
C_3 – Need for pest control
C_4 – Good Bio magnificat
C_5 – Cheap cost
C_6 –Availability of Endosulfan easily.
C_7 – No awareness of the effect of Endosulfan
C_8 – No knowledge on alternatives to Endosulfan
C_9 - Govt. negligence in farmers using Endosulfan.
C_{10} – No strict punishment for the usage of Endosulfan in farms.

Now we proceed on to apply the effect of combined overlap block NCM of equal length. Let us consider the ten concepts {C1, C2, ..., C 10}. We divide these concepts into cyclic way of classes, each having just four concepts in the following way.

S1 = {C1, C2, C3, C4, }, S2 ={C3, C4, C5,C6}, S3 = {C5 ,C6, C7 , C8, }, S_4= ={ C7, C8, C_9,C_{10}} S_5 = {C_9, $C_{10,}$ C_1 ,C_2}.

The directed graph and the relation matrix for the class S1, = {C1, C2, C3, C4,} given by the expert is as follows.



	C_1	C_2	C_3	C_4
C_1	0	1	0	0
C_2	0	0	1	0
C_3	0	1	0	0
C_4	0	0	1	0

Figure 1

The directed graph and the relation matrix for the class $S_2 = \{C_3, C_4, C_5, C_6\}$ given by the experts is as follows:

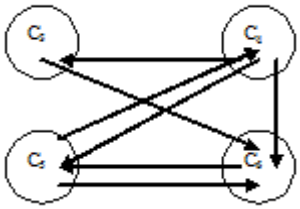
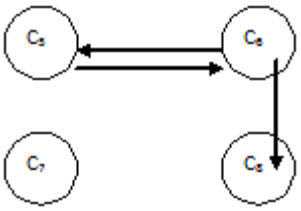


Figure 2

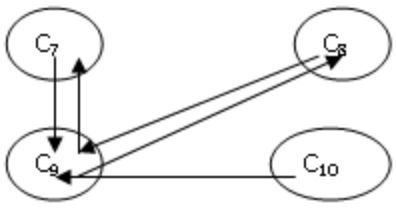
The directed graph and the relation matrix for the class S3 = $\{C_5, C_6, C_7, C_8\}$ given by the experts is as follows:



	C_5	C_6	C_7	C_8
C_5	0	1	0	0
C_6	1	0	0	1
C_7	0	0	0	0
C_8	0	0	0	0

Figure 3

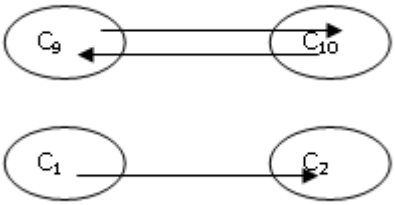
The directed graph and the relation matrix for the class S4 = $\{C_7, C_8, C_9, C_{10}\}$ given by the experts is as follows:



	C_7	C_8	C_9	C_{10}
C_7	0	0	1	0
C_8	0	0	1	0
C_9	1	1	0	1
C_{10}	0	0	1	0

Figure 4

The directed graph and the relation matrix for the class $S_5 = \{ C_9, C_{10}, C_1, C_2 \}$ given by the experts is as follows:



	C_9	C_{10}	C_1	C_2
C_9	0	1	0	0
C_{10}	1	0	0	0
C_1	0	0	0	1
C_2	0	0	0	0

Figure 5

The combined directed graph and combined overlap block FCM of equal sizes is as follows:

A =

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	2	0	0	0	0	0	0	0	0
C2	0	0	1	0	0	0	0	0	0	0
C3	0	1	0	0	0	1	0	0	0	0
C4	0	1	1	0	1	0	0	0	0	0
C5	0	0	0	1	0	2	0	0	0	0
C6	0	0	0	0	2	0	0	1	0	0
C7	0	0	0	0	0	0	0	0	1	0
C8	0	0	0	0	0	0	0	0	1	0
C9	0	0	0	0	0	0	1	1	0	2
C10	0	0	0	0	0	0	0	0	2	0

Figure 6

Now using the matrix A of the Combined overlap block FCM., we determine the hidden pattern.Suppose C4 is in the ON state and all the nodes are in the OFF state. Let the initial input vector be X = (0 0 0 1 0 0 0 0 0 0), where Good biomagnification is taken as the ON state and all other nodes are in the OFF state.

The effect of X on the dynamical system A is given by:

XA $\rightsquigarrow$ (0 1 1 0 1 0 0 0 0 0) = X1 (say)

$X_1A \rightsquigarrow (0\ 1\ 1\ 1\ 0\ 0\ 1\ 0\ 0\ 0) = X_{21}$ (say)

$X_2A \rightsquigarrow (0\ 1\ 1\ 0\ 1\ 1\ 0\ 1\ 0\ 0) = X_{31}$ (say)

$X_3A \hookrightarrow (0\ 1\ 1\ 1\ \ 1\ 1\ 0\ 1\ 0)$

$X_4A \hookrightarrow (0\ 1\ 1\ 1\ \ 1\ 1\ 0\ 1\ 1\ 0) = X_{51}$ (say)

$X_5A \hookrightarrow (0\ 1\ 1\ 1\ \ 1\ 1\ 1\ 1\ 1\ 1) = X_{61}$ (say)

$X_6A \hookrightarrow (0\ 1\ 1\ 1\ \ 1\ 1\ 1\ 1\ 1\ 1) = X_{7\,1}$ (say)

$X_7A \hookrightarrow (0\ 1\ 1\ 1\ \ 1\ 1\ 1\ 1\ 1\ 1) = X_8 = X_7$, a fixed point

(Where $\hookrightarrow$ denotes the resultant vector after thresholding and updating) X_7 is the hidden pattern, which is the fixed point.

4. CONCLUSION

While analyzing CFCM When C_4, "Good biomagnification" is in the ON state , the other concepts $C_2, C_3, C_5, C_6, C_7, C_8, C_9, C_{10}$ all are in the ON state except $C_1$is in the OFF state. Endosulfan is a good biomagnicant ie, if once used in farms it will be effective for years. Therefore, **Good biomagnification** is the major reason for using endosulfan in agriculture which leads to most dangerous side effects in human beings. Likewise one can work with one node or several nodes in the ON state and work with the problem.

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