Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Mathematics

Elixir Appl. Math. 77 (2014) 29311-29313

ISSN: 2229-712X

Predictors of interest in using Endosulfan by the farmers –An analysis using fuzzy cognitive maps (FCM)

K.Sivakamasundari and Smitha.M.V

Avinashilingam University for women Coimbatore-641043

ARTICLE INFO

Article history:

Received: 26 July 2014;

Received in revised form:

10 December 2014;

Accepted: 18 December 2014;

Keywords

Fuzzy cognitive Maps,

Pesticide endosulfan,

Agriculture,

Predicting factors.

ABSTRACT

Fuzzy cognitive maps (FCMS) are fuzzy graph structures representing casual reasoning. FCM was introduced by Bart Kosko in 1986 .A detailed report on the harmful effect faced by the people with the usage of pesticide in India was telecasted in star T.V.dated June 24, 2012 "SATYAMEVA JAYATHE" anchored by filim star Amir Khan. In this paper we study to identify the cause of using Endosulfan which leads to most dangerous side effects in human beings and animals. FCMs are more applicable when the data is an unsupervised one. As this problem involves more uncertainties FCM is one of the best tools to study the problem.

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Introduction

Political scientist R. Axelrod introduced cognitive maps for representing social scientific knowledge and describing the methods that are used for decision making in social and political systems. Fuzzy Cognitive Maps (FCMs) is a well established technique for prediction decision making especially for situations where fuzziness and uncertainty exist. Lofti A. Zadeh in 1965 introduced the notion of fuzziness. In 1986, Kosko, the guru of fuzzy Cognitive Maps introduced the Fuzzy Cognitive Maps. It was a fuzzy extension of the Cognitive Map pioneered in 1976 by Polical Scientists Robert Axelord, who used it to represent knowledge as an interconnected, directed bilevel logic graph, FCMs have a major role to play mainly when the data concerned is an unsupervised one.

We illustrate this by the following, which gives a simple FCM of a Socio-economic model. 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 endosulf an depends on the effects of Govt. and local citizen organizations to the preventive and proactive measures .Endosulfan is a pesticide which is a leading chemical used against a broad spectrum of insets and mites in agricultural like fruits, vegetables rice , grains, tea, coffee, cotton and rice . But Endosulfan is acutely toxic and is readily absorbed by the stomach and lungs, and even through skin . Symptoms of acute Endosulfan exposure include central nervous system disorders such as dizzilings, vomiting, diarrhooea, breathing difficulties, convulsions, and loss of consciousness. In extreme cases, death can result. The Stockholm Convention , a global treaty to protect human health and environment from such compounds, has declared Endosulfan a persistent organic pollutant and 73 countries have banned its use. Endosulfan was banned in Kerala in 2005 after the Centre issued a gazette notification withholding the use of Endosulfan in the state, on the basis of reports of National Institute of Occupational Health and other committees. But the ban has been ineffective. Nearly 300 landholders of Palakkad who own big plantations in the region use Endosulfan and other pesticides extensively during the flowering seasons to kill pests, leaf miners and leaf hoppers. The aerial spraying of Endosulfan over the cashew plantations in Kasargod district in Kerala was started in 1978.In this study we have interviewed 101 Enosulfan victims in Palakkad and Kasargod Dt. Of Kerala .These people are affected with the diseases like skin diseases, mentally retardation, epilepsy, autism, etc. Our aim is to find out the major reason for using Endosulfan and find out the remedial measures for it.

Fuzzy Cognitive Maps

Fuzzy Cognitive Maps are digraphs that capture the cause/effect relationsips in a system. Nodes of the graph stand for the concepts representing the key factors and attributes of the modeling system, such as inputs, variable states, components, factors. events, actions of any system. Signed weighted arcs describe the casual relationships, which exists among concepts and interconnect them with a degree of casuality. The constructed graph clearly shows how concepts influence each other and how much the degree of influence is. Cognitive Maps (CMs) were proposed for decision making by Axelord for the first time. Using two basic types of elements concepts and casual relationships, the cognitive map can be viewed as a simplified mathematical model of a belief system. FCMs were proposed with the extension of the fuzzified casual relationships. Kosko introduced FCMs as fuzzy graph structures for representing casual reasoning . When the nodes of the FCM are fuzzy sets then they are called fuzzy nodes FCMs with edge weights or casualities from the sets { -1, 0, 1} are clled simple FCMs.

Consider the nodes/concepts P_1, P_2, ……, Pn of the FCM. Suppose the directed graph is drawn using edge using weight e_{ij} from {-1, 0, 1}. The matrix M be defined by M={eij} where the eij is the weight of the directed edge PiPj. M is called the adjacency matrix of the FCM also known as connetion matrix.

The directed edge eij from the casual concept Pi to concept Pj measures how much Pi causes Pj . The edge e_{ij} takes values in the real interval { -1, 1}

$e_{ij}=0$ indicates no casuality $e_{ij}>0$ indicates casual increase /positive casuality.

$e_{ij}<0$ indicates casual decrese/negative casuality .

Tele:

E-mail addresses: sivanath2010@gmail.com

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Simple FCMs provide quick first hand information to an experts stated casual knowledge .Let P_1,P_2, …Pn be the nodes of FCM.Let A= (a_1, a_2,…..an) is called a state vector either ai=0 or 1. If ai=0 , the concept ci is in the ON state . for i=1,2, …n . Let P_1P_2,P_2P_3, …..PiPj be the edges of the FCM (i#j).Then the edges from the directed cycle . An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM with cycles is said to have a feedback. When there is a feedback in an FCM,that is, when the casual relations flow through a cycle in a revolutionary way, the FCM is called a dynamic system .The equilibrium state for the dynamical system is called the hidden pattern.

If the equilibrium state of a dynamical state is a unique state vector ,it is called a fixed point or limit cycle. Inference from the hidden pattern summarizes the joint effects of all interacting fuzzy knowledge.

Predicting factors in usage of Endosulfan – Undetermined factors

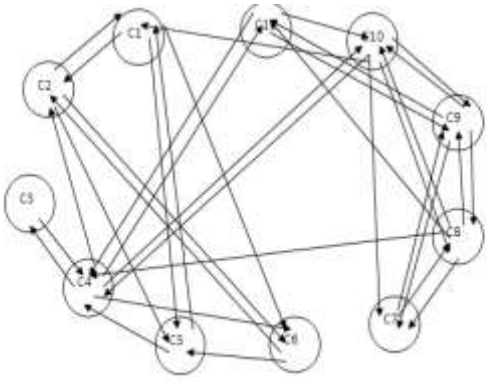
We have made o sample survey of 101 people in Kerala (Palakkad and Kasrgode). They were interviewed using a questionnaire relevant to the topic. According to their views , some of the factors as indicators are considered for our studies are given as follows.

Endosulfan affected girls[4]

The following are the eleven nodes taken by the experts

C_1 –Population Increase
C_2 –To increase food productivity
C_3 –Cheap cost
C_4 –Easy availability of Endosulfan
C_5- Need better yield
C_6 – Need for pest control
C_7 –Illeteracy
C_8-No awareness on ill effects of Endosulfan
C_9-No knowledge of any other non chemical alternative
C_{10}-Non involvement of social organization
C_{11}-Govt. indifference or negligence in farmers

The following represents the connection graph of the above eleven concepts and its connection matrix



M=	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_1	0	1	0	0	1	1	0	0	0	0	0
C_2	1	0	0	0	1	1	0	0	0	0	0
C_3	0	0	0	1	0	0	0	0	0	0	0
C_4	0	1	1	0	0	1	0	0	0	1	1
C_5	1	0	0	1	0	0	0	0	0	0	0
C_6	0	1	0	0	1	0	0	0	0	0	0
C_7	0	0	0	0	0	0	0	1	1	0	0
C_8	0	0	0	1	0	0	1	0	1	1	1
C_9	0	0	0	0	0	0	1	1	0	1	1
C_{10}	1	0	0	1	0	0	1	1	1	0	0
C_{11}	0	0	0	1	0	0	0	1	1	0	0

Consider the initial vector X= (0 0 0 0 0 0 0 1 0 0 0) the only node C8 ie, no awareness on the effects of Endosulfan is on state and all the rest are are in off state. Now passing X into the connection matrix M we get

$XM \hookrightarrow (0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 1\ 1) = X_1$
$X_1M \hookrightarrow (1\ 1\ 1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\ 1) = X_2$
$X_2M \hookrightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = X_3$
$X_3M \hookrightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = X_4 = X_3$, a fixed point.

Conclusion

While analyzing FCM When the node "no awareness on the effects of Endosulfan " is in the ON state make the rest of nodes to be off state. So we can conclude that no awareness on the effects of Endosulfan is one of 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 obtain results using FCM.

While working with the node "no awareness on the effects of Endosulfan" is in the ON state and making the rest of the node OFF state in FCM gives a fixed point in which all the FCM nodes become ON state. Hence the predictor "no awareness on the effects of Endosulfan" is the major reason for using Endosulfan in the agriculture fields.

Remdial Measures

Immediate remedial measures is finding alternative to Endosulfan. 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 Asion region farmers have developed their own combinations and methods of pest control using chillies, garlic, asafetida, cow urine and many other plant materials. In India

Endosulfan was recommended for controlling tea mosquito bug in cashew and tea until 2000. Following the Kasargod Tragedy, the National Research Centre for cashew has withdrawn its recommendation for Endoslfan use in cashew. Manycashew farmers have tried organic method and application of neem oil and pongamia leaf extract is found successful by some South Indian farmers.Some farmers have even tried 'do nothing' farming and the results are encouraging. Alternative pesticides and organic farming are encouraged in tea plantions and the use of Endosulfan is being eliminated. There are tea plantations in South India which has adopted bio dynamic farming and have completely eliminated the use of chemical pesticides including Endosulfan.

In coffee, to control coffee berry borer, Integrated Oest Management is adopted instead of Endosulfan. This includes strict phyto sanitary and cultural measures and mass trapping of the insects. Through alternatives to Endosulfan are available, support for such practices are very low. If Govt. support and research institutions can support such work, use of Endosulfan can be totally eliminated in agriculture and other sectors.

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