5

ESTIMATION OF THE MEASURES TO ELIMINATE THE USE OF ENDOSULFAN IN AGRICULTURE USING FUZZY MODELS

5.1: Introduction

Chemical pesticides have become a part of farming in India since the green revolution. With the growth of agrochemical industries in India, farmers have become dependent upon pesticides like endosulfan, which is cheap and easily available. Endosulfan is acutely toxic. It has been identified by the range of chronic effects and acute effects. A detailed study on all these effects were discussed in Chapter 4 .In this chapter the measures to stop using endosulfan by different mathematical models FCM, CFCM, IFCM and MFCM are analysed.

From the sample survey taken the following 16 concepts as the measures to stop using Endosulfan are derived.

C_1 –Prohibition or restriction of production, use , import and export of Endosulfan

C_2 –Use lower risk alternative pest control practices.

C_3 –Strengthen agricultural chemical control act.

C_4 –Adopt organic, ecological and natural agriculture.

C_5- Voluntary cancellation and phase out of all existing Endosulfan

C_6 – Promote online information service on non chemical pest management.

C_7 -Use crop rotation, inter cropping, field sanitation and mechanical methods.

C_8 - Use insecticides derived from natural plant extracts, natural soaps, neem, lemon grass

C_9 - Give awareness about the ill effects of Endosulfan

C_{10} - Give severe punishment for using Endosulfan

C_{11} - Support of Govt. and research Institutions

C_{12} - Involve NGO organizations.

C_{13} - Educated younger generation to enter agriculture.

C_{14} - Give free organic pesticides to farmers.

C_{15} - Improve the status of farmers by giving incentives and loans by Govt.

C_{16} - Award the informer on Endosulfan.

5.2: Selection of concepts for the study

C_1 –Prohibition or restriction of production, use, import and export

Ultimately, the action most ably protecting human and environmental health would be the withdrawal from sale of Endosulfan. This requires the agrochemical industry to rapidly phase out production of Endosulfan and to dispose of all stockpiles safely.At the Stockholm Convention, India had agreed to phase out the use of Endosulfan by 2017. The farmers must consciously stop using Endosulfan.

C_2 –Use lower risk alternative pest control practices

Alternative pest control practices reduce or eliminate the use of chemical pesticides. These ecological options improve the surrounding land and livelihood of farmers by eliminating the dependency on toxic insecticides, promoting local markets, and reducing food poverty by creating a long-term food source. These agroecological practices have shown to cost less for farmers than conventional practices, and in some cases, they cost nothing.

C_3 –Strengthen agricultural chemical control act

Our nation's main statute governing chemicals policy — The Toxic Substances Control Act (TSCA) — is seriously flawed and needs fundamental reform.Unlike every other major environmental law, the statute has never been significantly amended since it was adopted, from 1976.An Act to control and regulate the manufacture, storage, distribution and trade in use, importation and exportation of agricultural chemicals and for other purposes connected therewith.

C_4 –Adopt organic, ecological and natural agriculture.

Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and

enhance ecological harmony. Increasing environmental awareness in the general population in modern times has transformed the original supply-driven organic movement to a demand-driven one. Premium prices and some government subsidies attracted farmers.

C_5- Voluntary cancellation and phase out of all existing endosulfan

At the Stockholm Convention, India had agreed to phase out the use of Endosulfan by 2017.The Conference of Parties to the Stockholm Convention on Persistent Organic Pollutants, meeting in Geneva, approved non-chemical as well as chemical alternatives to Endosulfan .The farmers should realize and come out voluntarily with existing Endosulfan and promise not to use it anymore.

C_6 – Promote online information service for non chemical pest management.

Online Information Service for non-chemical pest management in the Tropics (OISAT) offers easy to read web-based information, relevant for small scale farmers in the tropics on how to produce key crops using affordable, preventive and curative non-chemical crop and pest management practices in a way that prevent pests and diseases by using non-chemical pest control measures. OISAT PartnerNetwork is a platform for information dissemination, information sharing/exchange, and the integration of the online information into training and extension services. Thus an effective and efficient information flow from web to field will be ensured.

C_7 –Use crop rotation, inter cropping, field sanitation and mechanical methods

Crop rotation is one of the oldest and most effective cultural control strategies. It means the planned order of specific crops planted on the same field. It also means that the succeeding crop belongs to a different family than the previous one. The planned rotation may vary from 2 or 3 year or longer period. Advantages of crop rotation are Prevent soil depletion, Maintains soil fertility, Reduces soil erosion, Controls insect/mite pests, Crop rotation as a means to control to insect pests is most effective when the pests are present before the crop is planted have no wide range of host crops; attack only annual/biennial crops; and do not have the ability to fly from one field to another, Reduces reliance on synthetic chemicals ,Reduces the pests' build-up and prevents diseases helps control weeds. Intercropping is the cultivation of two or more crops simultaneously on the same

field. Mechanical control methods are those that physically prevent the pest from attacking or injuring the crop. Hand weeding and use of fences to exclude deer and other wildlife are examples of mechanical, or physical controls. Mechanical controls such as vacuums, flaming, row covers, hand picking can all work but may have a high cost. Sanitation involves the removal of material which allows pests to survive or be transported between plants or crops.

C_8-Use insecticides derived from natural plants extracts, natural soaps, neem, lemon grass

Fortunately, there are a ton of effective techniques and natural products out there to help you deal with pests without chemicals. Nature has given us plant extracts that make very effective pesticides and insect repellents. For example, some organic pest control products such as Orange Guard use a citrus-fruit peel base, such as from lemons and oranges. Citrus oils kill many flying and crawling insects on contact by destroying the waxy coating of the insect's respiratory system.Some products use garlic or hot peppers and essential oils of herbs such as cloves to repel insects and other pests. Neem is a plant from India that has natural abilities to repel common pests. Combined with soapy water, this neem-based insecticide is a powerful and safe form of pest control.

C_9-Give awareness about the ill effects of Endosulfan

Education to farmers about judicious use of chemical pesticides and adopting good agricultural practices & ill effects of indiscriminate use of chemical pesticides. Awareness about the harmful effects of chemical pesticides, specially to farmers as they and their families will be exposed to it first. Use all medias to give awareness about ill effects of Endosulfan.They should be taught how to protect them from the deadly poison, to have regular follow up to health centres.

C_{10}-Give severe punishment for using Endosulfan

Delhi Health Minister A. K. Walia has said that the State Government would be enforcing the new Food Safety and Standard Act-2006 within the next three months, thereby ensuring heavy fine and punishment of up to life imprisonment for adulteration. Increasing the punishment, besides fine, incorporate stringent provision of punishment to

all offenders in the Food Safety and Standards Act, 2006 of food chain such as manufacturer/importer, dealer/retailer, farmer.

C_{11}-Support of Govt. and research Institutions

Endosulfan has been banned across 74 countries in all the continents after elaborate studies. In our own country Kerala and Karnataka have banned this chemical after finding health and environment damages. But it does not follow strictly in Kerala. The use of Bio-pesticides to be encouraged. To encourage the use of Bio-pesticides, farmers should be given assistance/subsidy by the government. Though alternatives to Endosulfan are available, support for such practices are very low. If the government and research institution can support such work, use of Endosulfan can be totally eliminated in agriculture and other sectors. The government should build canals, pumps and also provide electricity at low cost for watering. They should also make aware to the farmers about new good technologies for watering. The government is providing loan to farmers, but for that in some of the areas they have to pay bribes, for example a loan of 50,000 they pay bribe as 5000. So the government should take strong action against this.

C_{12}-Involve NGO organizations.

Below is a detailed chronology of CSE's campaign against Endosulfan and the tactics the pesticide industries used to suppress information, distort truth and discredit the whistle blowers Government started taking notes after 2000. From then committees of various departments, Non Governmental Organizations, Indian Council of Medical Research and other agencies conducted visits to the area, conducted studies and surveys to understand the relation between aerial spraying of endosulfan and the sudden spurt of health problems in the village. All studies recommended banning of aerial spray of Endosulfan in the area, accepted the evident lapses in precautionary measures followed by the PCK and acknowledged the fact that there were indeed a large number of people health abnormalities.

C_{13}-Educated younger generation to enter agriculture

Engaging youth in agriculture has been a prominent topic recently and has risen up the development agenda, as there is growing concern worldwide that young people have become disenchanted with agriculture Add Agriculture to the Curriculum.Offer Younger

Farmers a Voice Farming offers the young generation a chance to make a difference by growing enough food to feed the world.Those who become farmers now have the opportunity to be the generation that end world hunger and alleviate malnutrition, as well as helping the sector adapt to climate change. As we look to find solutions to feeding a world of nine billion people by 2050, it is this new generation that – working together – can help to achieve global development.

C_{14}- Give free organic pesticides to farmers

Organic foods are defined as those foods that are grown without the use of synthetic fertilizers or pesticides. Pesticides are chemical or control agents made to kill insects, weeds and fungal pests that damage crops. In large amounts these have been found to cause different illnesses including cancer.

C_{15}- Improve the status of farmers by giving incentives and loans by Govt

In order to improve farmer's conditions Government must know their problems which are as follows:

1. Fear of loss due to either drought or storm
2. Lack of proper knowledge about modern farming among the farmers.
3. Lack of knowledge about the facilities provided by the government
4. For some segments essential commodities act is becoming a big pain.
5. Lack of manpower
6. Lack of water resource

Government should provide proper subsidy for seed and fertilizer. Farmers are still using older model tractors and other machines. Some advance model machines are also available, but they are costly. So government should provide subsidy on such machinery.The government should buy directly from farmers at a proper rate without middle manGovernment should send agriculture scientists in each village panchyat and educate the farmers about which type of crop they should grow in which type of soil.

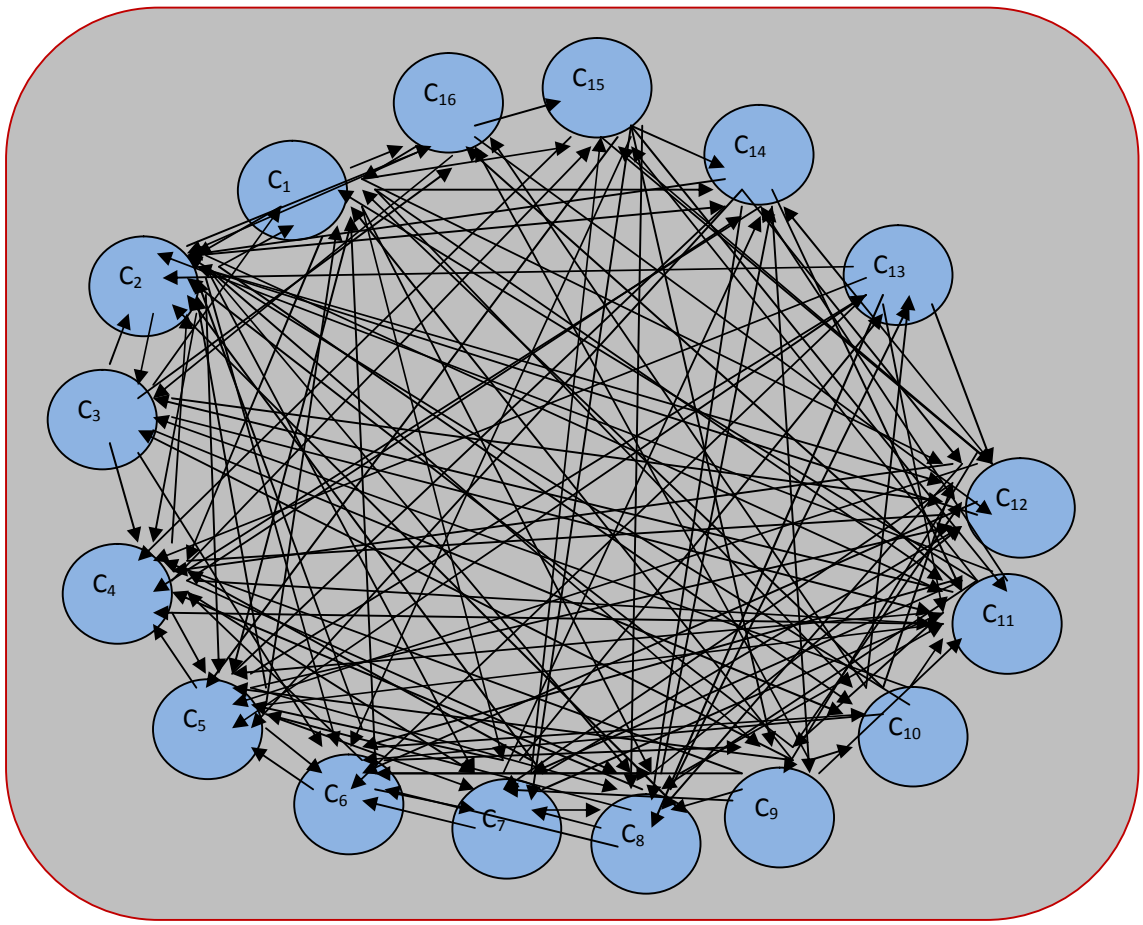
C_{16}-Award the informer on endosulfan

Give some award to the informer who tells about the usage of Endosulfan after the ban. Also give that news to media and newspapers. Such a propaganda can reduce the usage of Endosulfan. Slowl,y we can stop the usage completely using herbal pesticides.

5.3 Predicting the measures to eliminate the use of Endosulfan in agriculture using the method of FCM

5.3.1 Implementation of model to the study

Now taking the above 16 concepts as fuzzy node we proceed to give the directed graph using an expert's opinion.



Using the above directed graph, the connection matrix M= (a_{ij}) is formulated with

a_{ij} =1 if $C_i \longrightarrow C_j$

= 0 if $C_i \not\longrightarrow C_j$.

If increase in concept C_i leads to increase in another concept C_j then aij is given the value 1. Otherwise a_{ij} is given the value 0. It is important to note that the connection matrix is a square matrix with diagonal entries as zero.

M=

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}
C_1	0	1	0	1	1	0	1	1	0	1	1	1	0	1	1	1
C_2	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1
C_3	1	1	0	1	0	1	0	0	0	1	1	1	0	0	0	1
C_4	0	1	0	0	1	0	1	1	0	0	1	1	0	1	1	0
C_5	0	1	0	1	0	1	1	1	0	0	1	1	1	1	0	0
C_6	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0
C_7	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1	0
C_8	0	1	0	1	1	1	1	0	0	0	1	1	1	1	0	0
C_9	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1
C_{10}	1	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1
C_{11}	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1
C_{12}	0	1	0	1	1	1	1	1	1	0	0	0	0	1	1	0
C_{13}	0	1	0	1	1	1	0	1	0	0	1	1	0	0	0	0
C_{14}	0	1	0	1	1	0	0	1	1	0	1	1	0	0	0	0
C_{15}	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0	0
C_{16}	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0

A trial is conducted for the concept C_1. Consider the state vector P_1^1= (1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0) , the only node C_1 *ie "Prohibition or restriction of production, use , import and export"* is ON state and all the rest are in OFF state.Now passing P_1^1 into the connection matrix M .i.e., P_1^1M is calculated .It is modified by assigning 1 if the values of the entries are ≥1 and keeping first place always 1.

P_1^1M = (0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1) ↪(1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1) =P_2

P_2M is calculated and threshold as P_3

P_2M =(4 10 4 9 9 8 8 9 5 2 9 4 4 9 6 4)

↪(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)= $P_3 \neq P_2$

P_3M is calculated and threshold as P_4

P_3M =(7 14 5 13 12 11 10 12 6 5 12 14 4 9 6 6)

↪(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)=P_4=P_3, a fixed point is arrived.Hence when the concept *"Prohibition or restriction of production, use , import and export"* is in the ON state all the concepts become ON.Thus in all cases, a hidden pattern is obtained which is never possible by way of other statistical models. Thus this model is well suited to give the impact of each concept in finding the measures to stop using Endosulfan in

agriculture. Since the working becomes very laborious. A C++ program (Appendix III (j)) is used to find the fixed points which are listed below and applied. A conclusion is derived from these results is given in the next section

State Vector	Steps required to obtain fixed point	The fixed point
P_1^1=(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^2= (0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^3=(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^4=(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^5=(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^6=(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^7=(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^8=(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^9=(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)	STEP 3	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{10}=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	STEP 3	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{11}=(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{12}=(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{13}=(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{14}=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{15}=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	STEP 2	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)
P_1^{16}=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	STEP 3	(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)

5.3.2 CONCLUSION:

For the concepts C_1 (*Prohibition or restriction of production, use , import and export*), C_2 (*Use lower risk alternative pest control practi*ces), C_3 (*strengthen agricultural chemical control act), ,* C_4 (*Adopt organic, ecological and natural agriculture*),C_5 (*Voluntary cancellation and phase out of all existing Endosulfan*), C_6 (

Promote online information service for non chemical pest management), C_7 (*Use crop rotation, inter cropping, field sanitation and mechanical methods*), C_8(*Use insecticides derived from natural plants extracts, natural soaps, neem, lemon grass*), C_9(*Give awareness about the ill effects of Endosulfan*), C_{10}(*Give severe punishment for using Endosulfan*), C_{11}(*Support of Govt. and research Institutions*), C_{12}(*Involve NGO organizations)*, C_{13}(*Educated younger generation to enter agriculture*), C_{14}(*Give free organic pesticides to farmers*).C_{15}(*Improve the status of farmers by giving incentives and loans by Govt*.) the fixed point **(1 1 1 1 1 1 1 1 1 1 1 1)** are obtained in the 2nd step itself except for C_9(*Give awareness about the ill effects of Endosulfan*), C_{10}**(***Give severe punishment for using Endosulfan*) and C_{16}**(***Award the informer on Endosulfan*). All these concepts are considered to be major measures to stop the usage of Endosulfan as the fixed points are obtained having 1's in all places expressing their dependency.

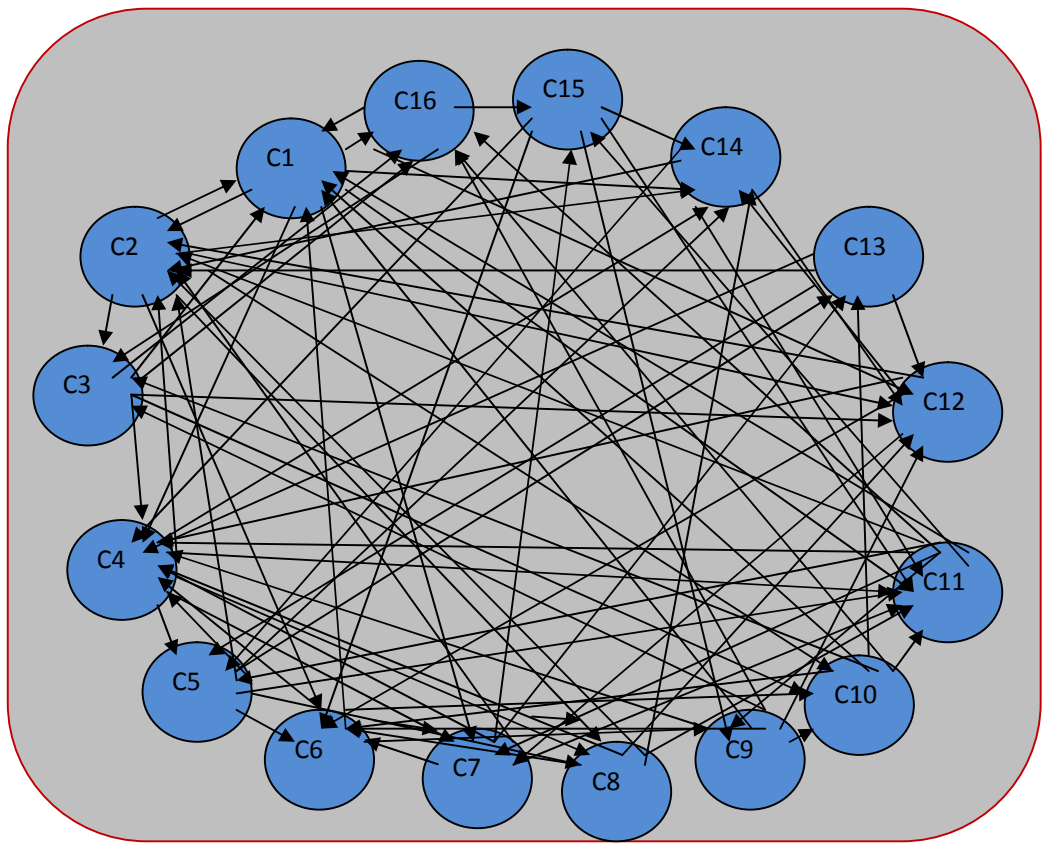
5.4 Identifying the Measures to Eliminate the use of Endosulfan Using Combined Fuzzy Cognitive Maps (CFCM)

5.4.1 Implementation of CFCM model to the study

The same problem of finding the measure to stop using Endosulfan through combined Fuzzy Cognitive Map is analyzed in this section. A finite number of FCMs can be combined together produce the joint effect of FCMs .This gives the result in an effective way by combining the opinions of 3 or more experts. For this model, giving the sixteen concepts considered in sec 5.2 to four experts (i) an agriculture officer (ii) an N.G.O (iii) a doctor (iv) a village administrative office, their opinions are collected .Then the connection graph and matrices are drawn from their responses.

5.4.2: Analysis of first expert's view

The first expert's opinion is arrived through responses from an agricultural officer for the connections between the concepts considered in section 5.2 The following represents the connection graph of the above sixteen concepts

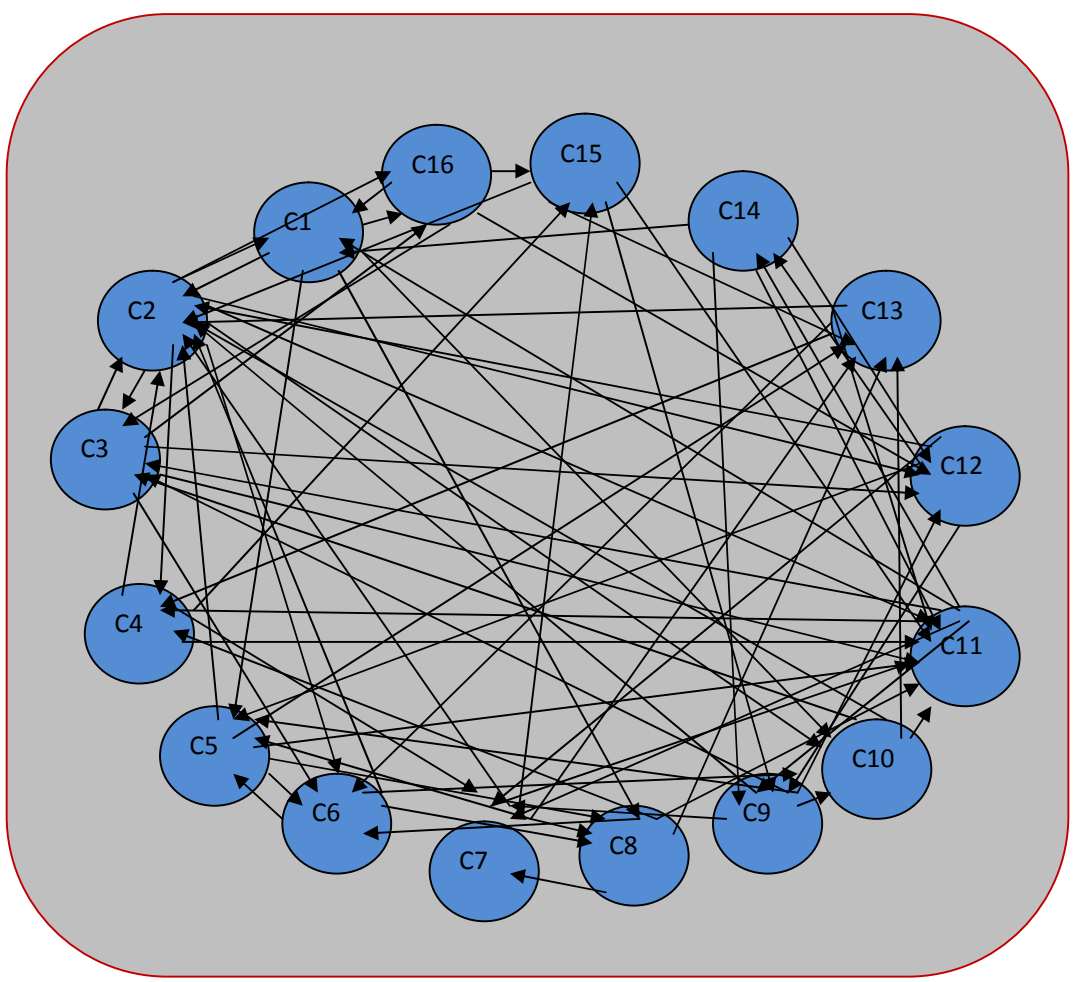


The related connection matrix is denoted by A for the above directed graph and is given below:

$$A = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \\ C_8 \\ C_9 \\ C_{10} \\ C_{11} \\ C_{12} \\ C_{13} \\ C_{14} \\ C_{15} \\ C_{16} \end{array} \begin{array}{c} \begin{array}{cccccccccccccccc} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 & C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} & C_{16} \end{array} \\ \begin{pmatrix} 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \end{pmatrix} \end{array}$$

5.4.3: Analysis of second expert's view

The second experts opinion is arrived through responses from an NGO for the connection between the sixteen concepts considered in section 5.2. The related graph is given below:

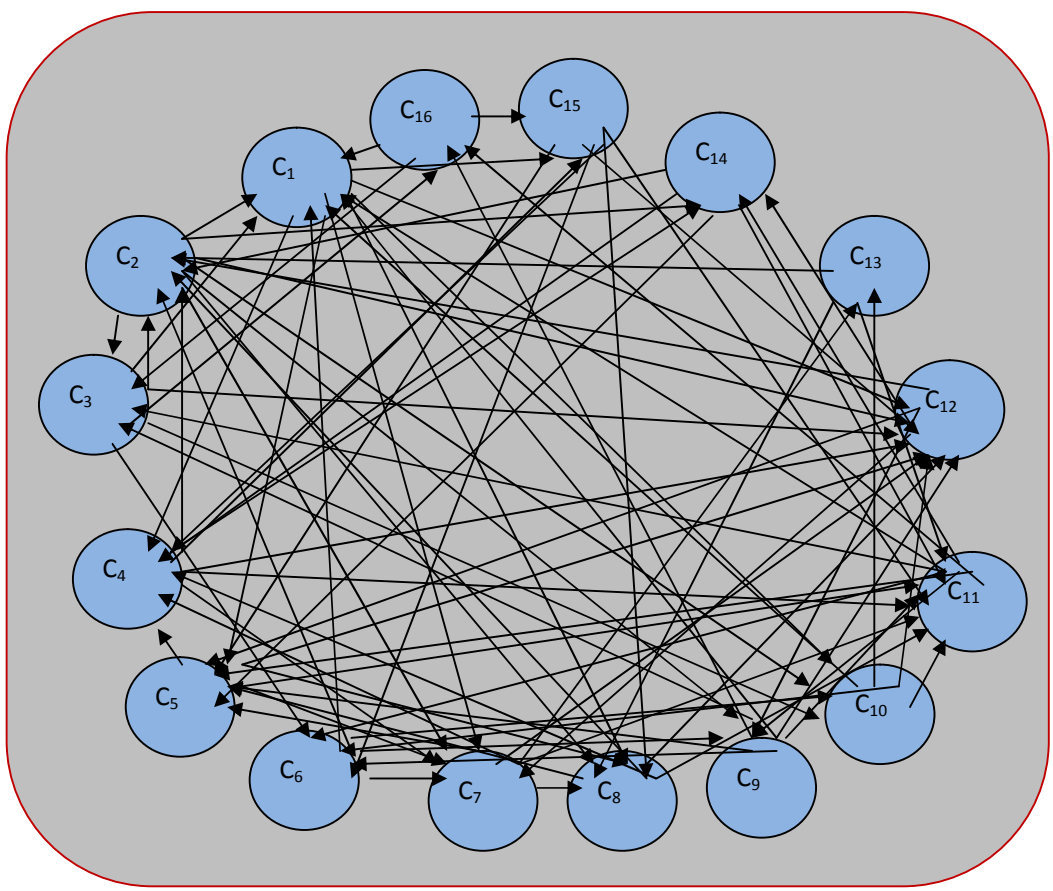


The related connection matrix is denoted by B for the above directed graph and is given below:

$$B = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \\ C_8 \\ C_9 \\ C_{10} \\ C_{11} \\ C_{12} \\ C_{13} \\ C_{14} \\ C_{15} \\ C_{16} \end{array} \begin{array}{c} \begin{array}{cccccccccccccccc} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 & C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} & C_{16} \end{array} \\ \begin{pmatrix} 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \end{pmatrix} \end{array}$$

5.4.4: Analysis of third expert's view

The third experts opinion is arrived through responses from a doctor for the connection between the concepts considered in section 5.2 . The following represents the connection graph of the above sixteen concepts .

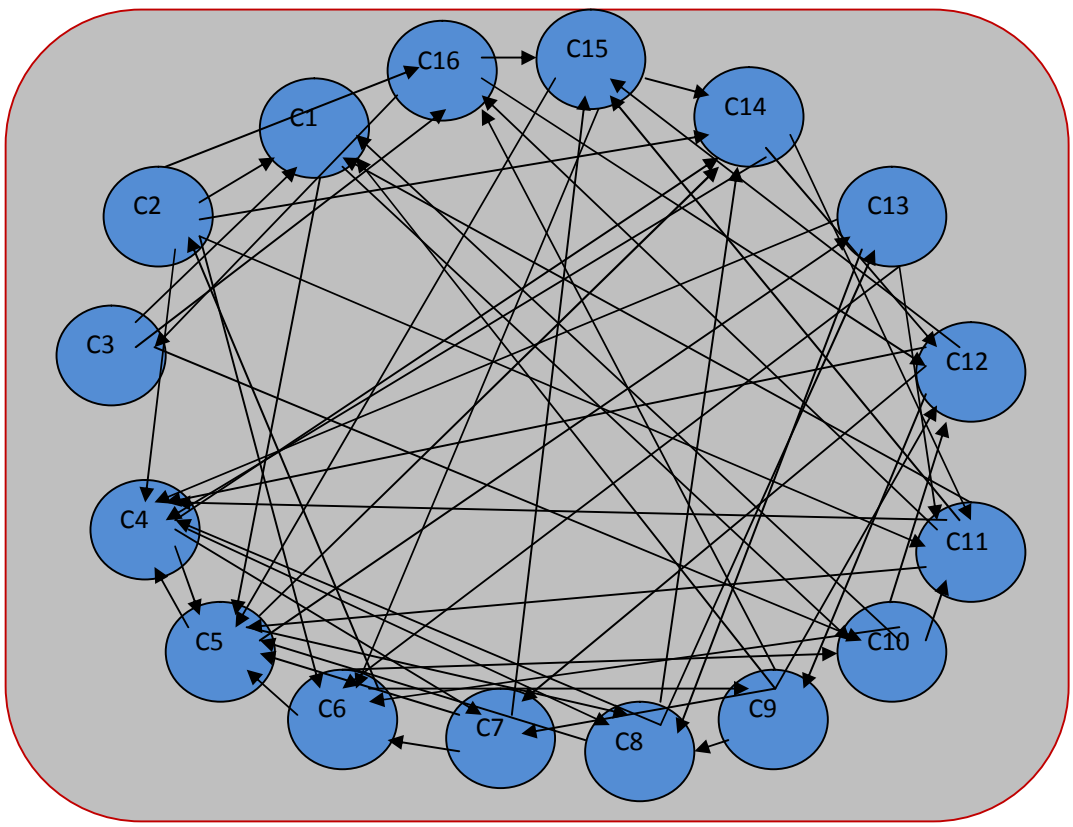


The related connection matrix is dented by C for the above directed graph.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}
C_1	0	0	0	1	1	0	1	1	0	1	0	1	0	0	1	0
C_2	1	0	1	0	0	0	1	1	1	1	0	1	0	1	0	0
C_3	1	1	0	0	0	1	0	0	0	1	0	1	0	0	0	1
C_4	0	1	0	0	0	0	1	0	0	0	1	1	0	1	1	0
C_5	0	0	0	1	0	0	1	1	0	0	1	1	0	0	0	0
C_6	1	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0
$C=C_7$	0	0	0	1	1	0	0	1	0	0	1	1	1	0	0	0
C_8	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0
C_9	1	0	1	0	1	1	0	0	0	0	1	1	0	0	0	1
C_{10}	1	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0
C_{11}	1	0	1	0	1	1	0	0	1	0	0	0	0	1	0	1
C_{12}	0	1	0	0	1	0	1	0	1	0	0	0	0	1	0	0
$_{13}$	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0
C_{14}	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0
C_{15}	0	0	0	1	1	1	0	1	0	0	1	1	0	0	0	0
C_{16}	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0

5.4.5 Analysis of fourth expert's view

The fourth expert's opinion is arrived through responses from a village administrative officer for the connection between the concepts considered in section 5.2. The following represents the connection graph of the above sixteen concepts.



The related conncetion matrix is dented by D for the above directed graph.

$$D=\begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \\ C_5 \\ C_9 \\ C_{10} \\ C_{11} \\ C_{12} \\ C_{13} \\ C_{14} \\ C_{15} \\ C_{16} \end{array}\begin{pmatrix} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 & C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} & C_{16} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \end{pmatrix}$$

5.4.6: Analysis of the problem containing all the four expert's view using CFCM

The CFCM using the opinion of the above four experts is formulated. Let S denote the combined connection matrix by S= A+B+C+D and the matrix is given by

$$S=\begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \\ C_8 \\ C_9 \\ C_{10} \\ C_{11} \\ C_{12} \\ C_{13} \\ C_{14} \\ C_{15} \\ C_{16} \end{array}\begin{array}{c} \begin{array}{cccccccccccccccc} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 & C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} & C_{16} \end{array} \\ \begin{pmatrix} 0 & 2 & 0 & 2 & 3 & 0 & 2 & 2 & 0 & 3 & 1 & 2 & 0 & 1 & 1 & 2 \\ 3 & 0 & 3 & 2 & 0 & 3 & 1 & 2 & 1 & 3 & 2 & 2 & 0 & 3 & 0 & 2 \\ 3 & 2 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 3 & 1 & 3 & 0 & 0 & 0 & 4 \\ 0 & 3 & 0 & 0 & 2 & 0 & 4 & 2 & 0 & 0 & 3 & 1 & 0 & 3 & 2 & 0 \\ 0 & 2 & 0 & 3 & 0 & 2 & 1 & 4 & 0 & 0 & 3 & 1 & 3 & 2 & 0 & 0 \\ 2 & 3 & 0 & 1 & 2 & 0 & 2 & 0 & 4 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 2 & 3 & 2 & 0 & 3 & 0 & 0 & 3 & 1 & 3 & 0 & 3 & 0 \\ 0 & 2 & 0 & 4 & 2 & 2 & 1 & 0 & 0 & 0 & 3 & 2 & 2 & 2 & 0 & 0 \\ 3 & 1 & 3 & 1 & 2 & 2 & 2 & 1 & 0 & 2 & 2 & 3 & 0 & 0 & 0 & 3 \\ 3 & 1 & 2 & 0 & 0 & 3 & 0 & 0 & 0 & 0 & 4 & 2 & 3 & 0 & 0 & 1 \\ 4 & 1 & 2 & 2 & 4 & 1 & 2 & 0 & 3 & 0 & 0 & 0 & 0 & 2 & 2 & 3 \\ 0 & 3 & 0 & 2 & 2 & 1 & 4 & 0 & 3 & 0 & 0 & 0 & 0 & 3 & 1 & 0 \\ 0 & 3 & 0 & 3 & 0 & 3 & 0 & 2 & 0 & 0 & 3 & 1 & 0 & 0 & 0 & 0 \\ 0 & 3 & 0 & 2 & 2 & 0 & 0 & 0 & 2 & 0 & 4 & 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 2 & 4 & 0 & 2 & 1 & 0 & 3 & 2 & 0 & 2 & 0 & 0 \\ 2 & 1 & 3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 & 0 & 3 & 0 \end{pmatrix} \end{array}$$

Consider the state vector P_1^1= =(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0) in which the only node C_1 *"Prohibition or restriction of production, use , import and export"* is ON state and all the rest are in OFF state. Now passing through the connection matrix S we get (0 2 0 2 3 0 2 2 0 3 1 2 0 1 1 2).

Here the threshold is done in a different way if an entry after multiplication is ≤2, then the value 0 is assigned and if ≥3, the value 1 is assigned keeping first place always 1.

P_1S=(0 2 0 2 3 0 2 2 0 3 1 2 0 1 1 2) ↪(1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0)=P_2

P_2S is calculated and threshold as P_3

P_2S=(3 5 2 5 5 3 8 2 0 5 8 5 3 3 1 3) ↪(1 1 0 1 1 1 1 0 0 1 1 1 1 1 0 1) =$P_3 \neq P_2$

P_3S is calculated and threshold as P_4

P_3S=(14 24 10 19 17 15 16 13 13 9 22 18 8) ↪ (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1) =$P_4 \neq P_3$

P_4S is calculated and threshold as P_5

P_4S=(20 29 13 28 24 19 18 14 14 32 26 11 18 12 15) ↪ (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)=P_5=P_4which is a fixed point for S.

Similarly we can work with any one of the nodes in ON state. A C++ computer program(Appendix III (k)) is written and applied. The result is listed below.

State Vector	Steps required to obtain fixed point	The fixed point
$P1^1$=(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^2$= (0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^3$=(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^4$=(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)	**STEP 2**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^5$=(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^6$=(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^7$=(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^8$=(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^9$=(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{10}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	**STEP 2**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{11}$=(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)	**STEP 2**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{12}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)	**STEP 2**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{13}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)	**STEP 2**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{14}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{15}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**
$P1^{16}$=(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	**STEP 3**	**(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)**

5.4.7 CONCLUSION

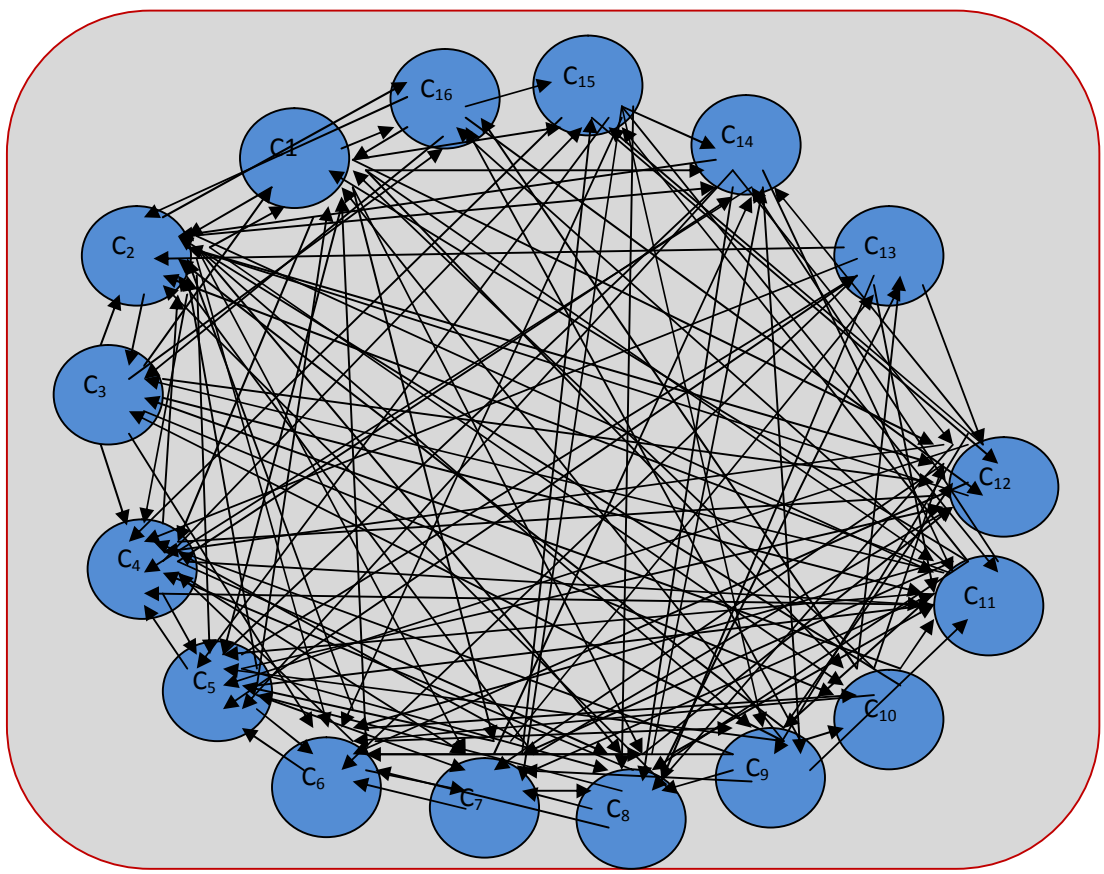
All the state vector get the same fixed point (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1). All concepts are interconnected. Hence all the concepts are measures to eliminate Endosulfan.

5.5 Deriving the Measures to Eliminate the Use of Endosulfan in Agriculture by Induced Fuzzy Cognitive Maps (IFCMS) Approach.

5.5.1 Implementation of IFCM model to the study

Induced Fuzzy Cognitive Maps (IFCM) is an advancement of FCM .The method is same as that of FCM until P_2 is calculated. Each component in P_2 vector is taken separately and multiplied with matrix M. Among these vectors, the vector which has the maximum number of 1's for the first time is considered as Q_2.Then the same procedure is repeated as done for P_2 until a fixed point is obtained.

The following represent the connection graph of the above sixteen concepts and its connection matrix as in section 5.2



M=

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}
C_1	0	1	0	1	1	0	1	1	0	1	1	1	0	1	1	1
C_2	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1
C_3	1	1	0	1	0	1	0	0	0	1	1	1	0	0	0	1
C_4	0	1	0	0	1	0	1	1	0	0	1	1	0	1	1	0
C_5	0	1	0	1	0	1	1	1	0	0	1	1	1	1	0	0
C_6	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0
C_7	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1	0
C_8	0	1	0	1	1	1	1	0	0	0	1	1	1	1	0	0
C_9	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1
C_{10}	1	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1
C_{11}	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1
C_{12}	0	1	0	1	1	1	1	1	1	0	0	0	0	1	1	0
C_{13}	0	1	0	1	1	1	0	1	0	0	1	1	0	0	0	0
C_{14}	0	1	0	1	1	0	0	1	1	0	1	1	0	0	0	0
C_{15}	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0	0
C_{16}	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0

5.5.2 Trial 1

Consider P_1^1 in the trial 1, by setting the concept C_1 to ON state, that is the first component of the vector is set to be 1 and the rest are assigned to be 0.

Then ,P_1^1 = (1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)

Product of P_1^1 and M is calculated.

P_1^1M=(0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1) = P_2

Now as per Induced Fuzzy Cognitive Map methodology, each component in the P_2 vector is taken separately and product of the given matrix is calculated. The vector which has the maximum number of one's which occurs first is considered as Q_2

$P_2M \approx$

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 0 1 1 1 1 1 1 1 1 1 0 1 0 1)= Q_2

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 0 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1=0 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M= (1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 0 0 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M= (0 1 0 1 1 1 1 1 0 0 0 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M= (0 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)M= (0 0 0 1 1 1 1 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M= (1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 1 0)

Q_2=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1) $\neq P_2$, so the iteration continues

Product of Q_2 and M is calculated and modified by assigning 1 if the values of the entries are $\geq$1 Let the modified vector be $Q_2^{\square}$

Q_2M= (6 13 6 12 11 10 11 6 6 11 11 5 8 7 6 5) $\hookrightarrow$(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)= $Q_2^{\square}$.

Now each component in the vector $Q_2^{\square}$ is taken separately and product of it with the given matrix is calculated.The vector which has maximum number of one's is found and is called R_3

$Q_2^{\square}$M $\approx$

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M =(0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)= R_3

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 0 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 0 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 0 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M= (1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M= (0 1 0 1 1 1 1 1 1 0 0 0 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M= (0 1 0 1 1 1 0 1 0 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M= (0 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)M= (0 0 0 1 1 1 1 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M↪=(1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 0)

Here R_3=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)=Q_2. Hence the fixed point is (1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1).

The triggering pattern is $C_1 \rightarrow C_2 \rightarrow C_2$

5.5.3 Trial 2

The calculation for Trial 2 is performed similar to the Trial 1,. Consider P_1^2 by setting C_2 in ON state that is, assigning the second component of the vector to be 1 and the rest of the component as 0.

Let P_1^2=(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)

Product of P_1^2 and M is calculated.

P_1^2M= (0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M =(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)=P_2

Now each component in the P_2 vector is taken separately and product of it with the given matrix is calculated. The vector which has the maximum number of one's which occurs first is considered as Q_2

P_2M ≈

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 0 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 0 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 0 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M= (1 1 1 1 1 1 1 0 1 1 1 0 0 0 1)= Q_2

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M= (1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M= (0 1 0 1 1 1 1 1 1 0 0 0 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M= (0 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M= (1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 0)

That is, Q_2 =(1 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1) ≠P_2, So the iteration continues

Then Q_2M is calculated and modified by assigning 1 if the values of the entries are $\geq$ 1. Let the modified vector be Q_2▫

Q_2M = (5 11 4 9 8 8 8 8 4 4 4 9 3 8 6 5) ↪ (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1) = Q_2▫

Now each component in the vector Q_2▫ is taken separately and product of it with given matrix is calculated. The vector which has maximum number of 1s is found and is called R_3.

Q_2▫M ≈

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M =(0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)= R_3

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M =(0 1 0 0 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M =(0 1 0 1 0 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 0 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M= (1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M =(1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M=(0 1 0 1 1 1 1 1 1 0 0 0 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M =(0 1 0 1 1 1 0 1 0 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M= (0 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)M= (0 0 0 1 1 1 1 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M= (1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 0)

Now the vector with maximum number of 1's be R_3.

R_3.=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1) $\neq$ Q_2.So the iteration continues.

Then R_3M is calculated and modified by assigning 1 if the values of the entries are ≥ 1. Let the modified vector be $R_3^{\square}$

R_3M=(6 11 4 9 8 8 8 8 3 4 8 9 3 7 5 5))$\hookrightarrow$(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)= $R_3^{\square}$

Now each component in the vector $R_3^{\square}$ is taken separately and product of it with the given matrix is calculated. The vector which has maximum number of 1s is found and is called S_4.

$R_3^{\square}M \approx$

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M =(0 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)= S_4

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M=(0 1 0 0 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 0 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M= (1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 0 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M= (0 1 0 1 1 1 1 0 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M= (1 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M= (1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M =(1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M=(0 1 0 1 1 1 1 1 1 0 0 0 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M =(0 1 0 1 1 1 0 1 0 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M= (0 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M= (0 0 0 1 1 1 1 1 1 0 1 1 0 1 0 0)

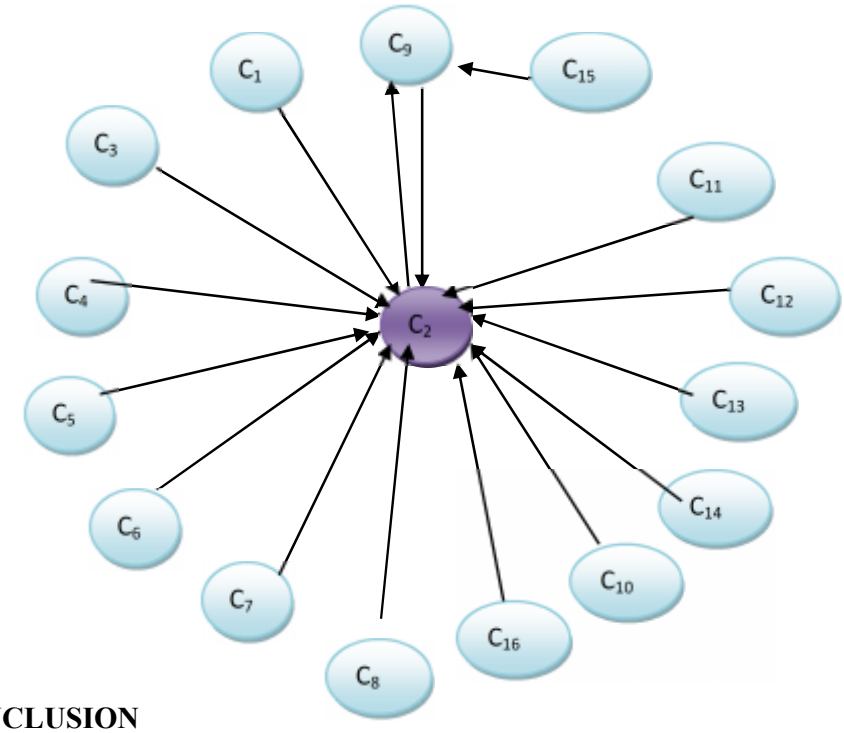
(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M= (1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 0)

Here R_3=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)= S_4 . Hence the fixed point is =(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1) . Here the triggering pattern is $C_2 \rightarrow C_9 \rightarrow C_2 \rightarrow C_2$.

A C++ Computer Program (Appendix III(l) is used to find out the triggering patterns when other attributes are kept in ON state. The following table gives the triggering patterns for each concept.

Number	Attribute on State	Triggering Pattern
Concept 1	C_1: (1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	$C_1 \rightarrow C_2 \rightarrow C_2$
Concept 2	C_2: (0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	$C_2 \rightarrow C_9 \rightarrow C_2 \rightarrow C_2$
Concept 3	C_3: (0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)	$C_3 \rightarrow C_2 \rightarrow C_2$
Concept 4	C_4: (0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)	$C_4 \rightarrow C_2 \rightarrow C_2$
Concept 5	C_5: (0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)	$C_5 \rightarrow C_2 \rightarrow C_2$
Concept 6	C_6: (0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)	$C_6 \rightarrow C_2 \rightarrow C_2$
Concept 7	C_7: (0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)	$C_7 \rightarrow C_2 \rightarrow C_2$
Concept 8	C_8: (0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)	$C_8 \rightarrow C_2 \rightarrow C_2$
Concept 9	C_9: (0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)	$C_9 \rightarrow C_2 \rightarrow C_2$
Concept 10	C_{10}: (0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)	$C_{10} \rightarrow C_2 \rightarrow C_2$
Concept 11	C_{11}: (0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)	$C_{11} \rightarrow C_2 \rightarrow C_2$
Concept 12	C_{12}: (0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)	$C_{12} \rightarrow C_2 \rightarrow C_2$
Concept 13	C_{13}: (0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)	$C_{13} \rightarrow C_2 \rightarrow C_2$
Concept 14	C_{14}: (0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)	$C_{14} \rightarrow C_2 \rightarrow C_2$
Concept 15	C_{15}: (0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)	$C_{15} \rightarrow C_9 \rightarrow C_2 \rightarrow C_2$
Concept 16	C_{16}: (0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)	$C_{16} \rightarrow C_2 \rightarrow C_2$

Merging of all these graphs on a single graph , the following graph is obtained.



5.5.4 CONCLUSION

All the concepts except C_{15} have direct impact to the same fixed point. **(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)** which is the vector corresponding to the concept C_2. Hence, the interrelationships between the attributes reveal that C_2-*"Use lower risk alternative pest control practices.*" is the terminal node.The triggering pattern $C_2 \rightarrow C_9 \rightarrow C_2 \rightarrow C_2$ implies that C_9-*Give awareness about the ill effects of Endosulfan* plays the role of intermediary node. The limiting point corresponding to C_2(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1) highlights that attribute C_1, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10}, C_{11}, C_{12}, C_{14}. C_{16} which seem to be the major measures to stop the usage of Endosulfan in agriculture.Hence the conclusion arrived in this model is that the major measures to stop the usage of Endosulfan are:

C_1 –Prohibition or restriction of production, use, import and export

C_2 – Ues lower risk alternative pest control practices

C_3 –strengthen agricultural chemical control act.

C_4 –Adopt organic, ecological and natural agriculture.

C_5- Voluntary cancellation and phase out of all existing Endosulfan

C_6 – Provide online information service for non chemical pest management.

C_7 –Use crop rotation, inter cropping, field sanitation and mechanical methods.

C_8-Use insecticides derived from natural plants extracts, natural soaps, neem, lemon grass

C_9-Give awareness about the ill effects of Endosulfan

C_{10}-Give severe punishment for using Endosulfan

C_{11}-Support of Govt. and research Institutions

C_{12}-Involve NGO organizations.

C_{14}- Give free organic pesticides to farmers.

C_{16}-Award the informer on Endosulfan.

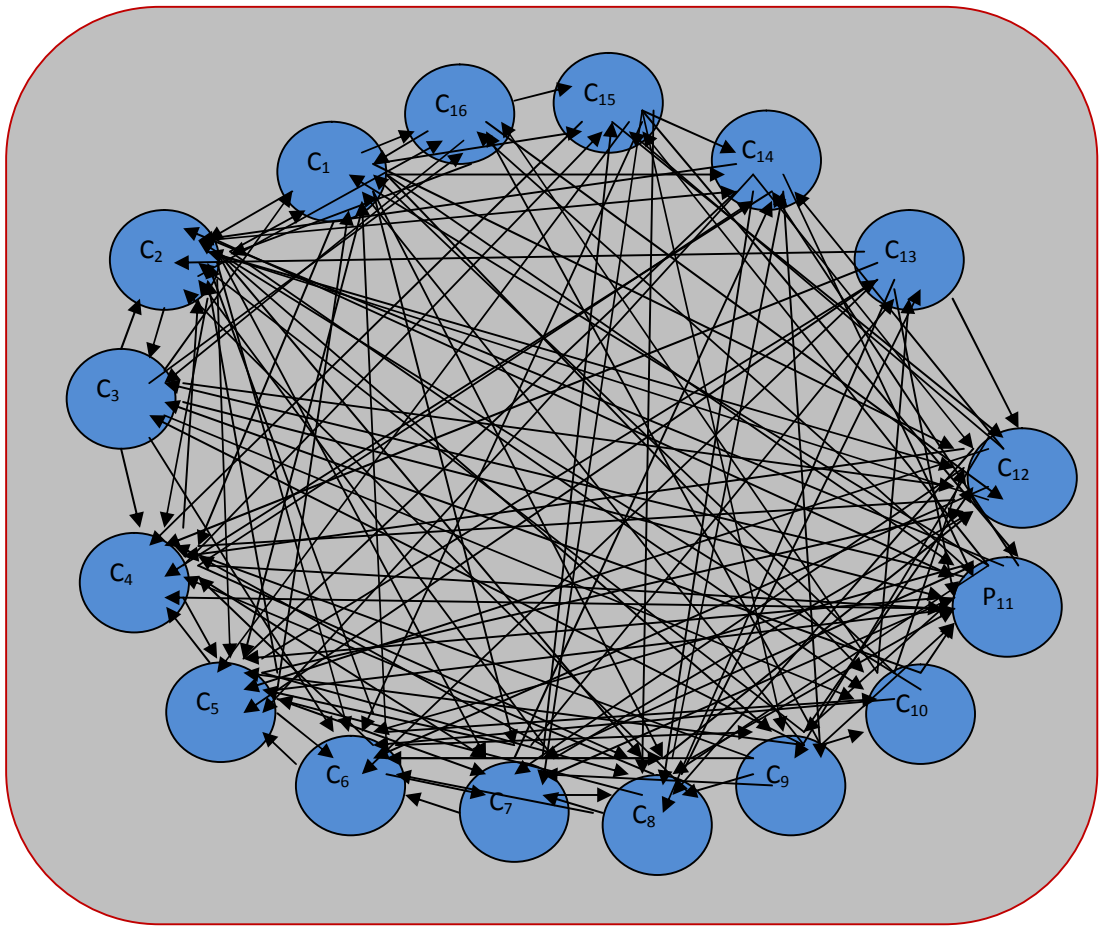
2. The triggering pattern shows that C_2 and C_9 are related. ie, Giving awareness about the ill effects of Endosulfan to the farmers will result in the usage of lower risk alternative pest control practices.

5.6 Analysis of The Measures To Elminate The Use Of Endosulfan In Agriculture By Maximum Fuzzy Cognitive Maps (MFCM)

5.6.1 Implementation of MFCM model to the study

MFCM is an advancement of FCM. It follows the foundation of FCM. It has a slight modification only in algorithm approache. The following steps to be adopted to derive an optimistic solution to the problem to an unsupervised data by MFCM model is explained in Chapter III.

The following represent the connection graph of the above 16 concepts and its connection matrix as in section 5.2.



M=

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}
C_1	0	1	0	1	1	0	1	1	0	1	1	1	0	1	1	1
C_2	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1
C_3	1	1	0	1	0	1	0	0	0	1	1	1	0	0	0	1
C_4	0	1	0	0	1	0	1	1	0	0	1	1	0	1	1	0
C_5	0	1	0	1	0	1	1	1	0	0	1	1	1	1	0	0
C_6	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0
C_7	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1	0
C_8	0	1	0	1	1	1	1	0	0	0	1	1	1	1	0	0
C_9	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1
C_{10}	1	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1
C_{11}	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1
C_{12}	0	1	0	1	1	1	1	1	1	0	0	0	0	1	1	0
C_{13}	0	1	0	1	1	1	0	1	0	0	1	1	0	0	0	0
C_{14}	0	1	0	1	1	0	0	1	1	0	1	1	0	0	0	0
C_{15}	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0	0
C_{16}	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0

From the above matrix M the row having maximum number of 1s occurring first is C_2 here. Now call C_2 as R_1.

Let R_1=(1 0 1 1 1 1 1 1 1 1 1 1 0 1 0 1)

Each component in R_1 vector is taken separately and the product of it with M is calculated and thresholded.

$R_1 \circ M \approx$

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 1 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 0 1 1 1 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M↪ (1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1)=R_2

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M↪ (1 1 1 0 0 1 0 0 0 1 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M↪ (1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 1 0 0 1 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M↪ (0 1 0 1 1 0 0 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M↪ (0 1 0 1 1 0 0 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)M↪ (1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 1)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M↪ (1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 1)

The vector having maximum number of 1s is taken as R_2

R_2= (1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1) ≠ R_2

Product R_2M is calculated and threshold as R_2 ∘

R_2M==(1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1)M= (6 12 5 10 10 10 9 9 4 5 9 10 4 8 5 6)

↪ (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)= R_2∘

Each component in R_2 ∘ vector is taken separately and the product of it with M is calculated and threshold R_2M is obtained.

$R_2 \circ M \approx$

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪(1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪(1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1)=R_3

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪(1 1 1 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M↪(0 1 0 1 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M↪(0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M↪(1 1 0 1 1 1 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M↪(0 1 0 1 1 1 1 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M↪(0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M↪(0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M↪(1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M↪(1 1 1 0 0 1 0 0 0 1 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M↪(1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 1)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M↪(0 1 0 1 1 1 1 1 1 0 0 1 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M↪(0 1 0 1 1 1 0 1 0 0 1 1 1 0 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0)M↪(0 1 0 1 1 0 0 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M↪(0 0 0 1 1 1 1 1 1 0 1 1 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M↪(1 1 1 0 0 0 0 0 0 0 0 1 0 0 1 1)

The vector having maximum number of 1's is taken as R_3

R_3=(1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1) $\neq R_2$ Thus the iteration is continued

Product R_3M is calculated and threshold as $R_3 \circ$

R_3M= (7 14 5 13 12 11 10 12 6 5 12 14 4 9 6 6)=(1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1)= $R_3 \circ$

Each component of $R_3 \circ$ vector is taken separately and product of it with M is calculated and threshold.

$R_3 \circ M \approx$

(1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1)

(0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1)=R_4

(0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 1 1 0 1 0 0 0 1 1 1 0 0 0 1)

(0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 0 1 1 0 0 1 1 0 1 1 0)

(0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0)M↪ (1 1 0 1 1 1 1 1 1 1 0 0 0 0 0 0)

(0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 1 0)

(0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0)M↪ (0 1 0 1 1 1 1 1 0 0 1 1 1 1 0 0)

(0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0)M↪ (1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 1)

(0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0)M↪ (1 1 1 0 0 1 0 0 0 1 1 1 1 0 0 1)

(0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0)M↪ (1 1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1)

(0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0)M↪ (0 1 0 1 1 1 1 1 1 0 0 1 0 1 1 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0)M↪ (0 1 0 1 1 0 0 1 1 0 1 1 0 1 0 0)

(0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1)M↪ (1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 1)

The vector having maximum number of 1s is taken as R_4

R_4= (1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1)=R_3

When the same threshold value occurs twice, the value is considered as the fixed point. The iteration gets terminated and the calculation gets terminated.

A computer program C++ (Appendix III (m)) isalso framed to work the follwoing method.

5.6.3 CONCLUSION

In MFCM model we arrive at a fixed point (1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1) The above fixed point vector nothing but the second row of the casual connection matrix M after thresholding. That is, "Use lower risk alternative pest control practices". We can conclude that this factor as the most impactful factor in this study even though many attributes present. The other interdependent attributes having impact on the

estimation of the measures to stop the usage Endosulfan in agriculture are C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9 C_{10}, C_{11}, $C_{12,}$ C_{14} and C_{16} which are the places in which 1 is present in the fixed point .This is the same fixed point we have arrived in section 5.5, while working with the IFCM model. We have have performed 16 trials and got various fixed points in IFCM where as in MFCM model there is only 1 trial giving the same fixed point. This model consumes less time and focuses only on a particular fixed point unlike getting various fixed points leading to vagueness. Hence this model is much suitable to work for the unsupervised data to find the most impactful factors. But in IFCM model the impact of each concept on other concepts can also be found which is an advantage of IFCM.