



SUMMARY AND CONCLUSION

In this research, different types of FCM models are applied to a real life problem. Here the problems faced by the people of Kerala by the usage of deadly pesticide Endosulfan in agriculture are analysed. The causes, various effects and preventive measures to stop the usage of Endosulfan in agriculture are determined using FCM, CFCM, IFCM and a newly introduced model MFCM. Since the data is an unsupervised one, FCM models are the best tool to study the problem.

Chapter 1 discusses about the deadly pesticide Endosulfan and its effects to human being, wild domestic animals, air, water and land and various models of FCM. In Chapter 2, the maximum age group victims of Endosulfan using CETD fuzzy matrices is estimated. Chapter 3 explains the analysis of the causes for using Endosulfan in agriculture by various fuzzy cognitive maps. Chapter 4 is a study of the reasons for various effects by Endosulfan in agriculture using fuzzy models and some suggestions are given. Chapter 5 deals with the study of the measures to eliminate the use of Endosulfan in agriculture using fuzzy models and finally some remedial measures for it are listed out.

The newly introduced model MFCM 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.

RECOMMENDATIONS

For every research it is of high importance to access the quality of the end product. As an end product, some recommendations are collected to protect people and the planet from the hands of the deadly pesticide Endosulfan.

Recommendations to protect people and planet from the hands of the deadly pesticide Endosulfan

The study considers the overwhelming evidence that the dangers associated with the use of Endosulfan outweigh its benefits. Further, the study summarizes the robust

evidence of the considerable threats that Endosulfan poses to human health and environmental security. In light of the evidence (by the mathematical analysis) a number of recommendations are presented to key decision makers, with the ultimate aim of attaining a global ban of this deadly chemical pesticide.

Global Ban

- Endosulfan is a highly dangerous and outdated chemical, the safe use of which cannot be guaranteed by many poor countries where it is still used. Government should ban Endosulfan usage and the Designated National Authorities in countries which are signatories of the Rotterdam Convention should propose the chemical for inclusion in the Convention's Prior Informed Consent procedure.
- Endosulfan is a persistent chemical which has been demonstrated to bioaccumulate in organisms that are exposed to Endosulfan. As such, it should be included on the list of Persistent Organic Pollutants targeted for global elimination of pesticide Endosulfan by the Stockholm Convention.



- Further, to promote better practice, the World Health Organisation should: upgrade endosulfan from Class II (moderately hazardous) to Class Ib (highly hazardous), in line with the USA's EPA classification. Such a move would assist countries like Cambodia which has banned all Class Ia and Ib chemicals, to promote safer agrochemical practices.

- Ultimately, the action that will most ably protect human health and environment would be the withdrawal from sale of Endosulfan. This requires the agrochemical industry to rapidly relinquish the production of Endosulfan and to dispose of all stockpiles safely.

Alternate Pesticide

- Safe alternatives to Endosulfan must be researched, identified and widely promoted. Pesticides Action Network Asia-Pacific lists a number of alternatives to endosulfan that can be used in different agricultural contexts (PANAP 1996). These include the use of botanical pesticides (neem extracts), parasitic wasps in rice production, and baculoviruses which are natural enemies as well as pheromone traps that are used to control cotton pests.
- Endosulfan is not the only viable option for protecting crops. Promoting sustainable, economically and technically viable alternatives to Endosulfan will help secure public and environmental health.
- Organic farming... saves lives by not using pesticides. We no longer have debt problems. Income is all profit at the end of the season. Land and soil are preserved.
- Benin Farmer Gera Paul
- Organic farming is better for the environment, safer for workers and could increase profit margins for farmers
- There are numerous botanical pesticides that can be produced and used by farmers with comparably low risk to health. These include larvaticides which are formulated using aloe extract, plants which act as repellants like lemongrass and coriander. Further, cow urine or buttermilk solutions can be utilized and ginger, chilli can be adopted as insecticides.
- For example, Neem is a repellent, insecticide, antibacterial agent, anti-fungal agent, antifeedant, a growth inhibitor, and crop protectant. It is not harmful to beneficial species like earthworms. Further, its target species such as leafhoppers, aphids, and whitefly do not build up a resistance to it (organic exchange 2008).

Organic farming and Integrated Pest Management (IPM)

- Integrated Pest Management (IPM) is a method of reducing or avoiding some of the worst aspects of chemical pesticide usage.
 - ✓ There can be no doubt that a switch to organic farming can have economic advantages. Market research shows that premium prices are favourable towards organic products.
 - ✓ Switching would also have environmental benefits – such as increase in soil fertility and healthy living. People would benefit from improved health and would spend less on medicine to treat the results of exposure to pesticides (Lakhal 2007).
- The focus of IPM is on the cultural and biological control of pest rather than depending on chemical pesticides.

Upliftment of Farm Labourers/Farmers

- The farm labourers live within the orchards or in colonies. They must be provided house dwellings away from the area where Endosulfan is sprayed.
- Endosulfan affected people must be given proper medical care
- Government should often conduct medical camps to find the victims of Endosulfan and they must be treated free of cost with the proper follow up.
- Farmers/labourers must be informed of IPM and they must be given alternative organic pesticides for free of cost.
- All media must create awareness on the ill effects of Endosulfan.
- Illiteracy and poverty are the major cause for using Endosulfan. Therein, people must be educated. Government can help them by giving incentives for applying IPM and alternative organic pesticides.
- The Government must take necessary steps to implement the rehabilitation measures as per their plan during the consultative workshop held in 2005.
- The R&R cell should be updating the list of victims periodically so as to improve the health condition of the victims.
- Proper and regular medical facility has to be promised to the victims by giving extra dividend or reward to the medical officers in order to motivate them to work at the affected areas.

- The NGO's should make their contribution in recognizing the affected children and helping them in getting into the Buds Schools by properly educating their parents and family.
- Apart from R&R cell many non-profit organizations should come forward to undertake projects to improve the status of the families by conducting parent training, medical and rehabilitation measures.
- As seen from our study, people of age below 20 are mostly affected out of which many are children with mental disorders. These children must be cared specially and opportunities for social interaction has to be given. Children with mild mental disability must be given formal education.
- Government should waive the debt of Endosulfan victims. It is seen from newspapers that Endosulfan victims go on hunger strike seeking justice on Manorama (2016). Demanding immediate disbursal of the compensation amounts to them. Government should take measures to ensure that the funds and packages are reaching the victims on time thereby preventing the Endosulfan victims from undergoing hungerstrikes.



- **Endosulfan has killed, and will continue to kill and maim if it continues to be legal. National prohibitions on use, together with inclusion of it under the Stockholm Convention will ensure Endosulfan's eradication from global use. This will ultimately provide an opportunity to protect people and their shared environment from this deadly chemical.**



THE FOLLOWING PROBLEMS OF FURTHER STUDY ARE SUGGESTED

Different types of FCM models can be applied to number of real life problems. The same problem can be discussed with the help of Triangular FCM and DEMATEL Model etc.