CHAPTER V

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APPLICATION OF FUZZY COGNITIVE MAPS IN THE ANALYSIS OF THE PROBLEMS ENCOUNTERED BY THE COFFEE CULTIVATORS IN KODAI HILLS [11]

Introduction

The coffee industry of India is the sixth largest producer of coffee in the world. Indian coffee is said to be the finest coffee grown in the shade rather than direct sunlight anywhere in the world. Three southern states of South India (Karnataka, Kerala and Tamil Nadu) account for 98 % of coffee production in India. Well known varieties of coffee grown are the Arabica and Robusta. In the study area Arabica variety is grown. Coffee is a labour-intensive crop and in Kodai Hills coffee is grown under monsoon rainfall conditions. As the coffee contributes significantly for the national economy and the growers face many hardships in coffee cultivation, a research has been conducted to study the problems encountered by them and inferences were drawn using combined Fuzzy Cognitive Maps.

Application of Fuzzy Cognitive Interval Maps

In order to analyse the problems encountered by the coffee cultivators, an interview schedule was administrated to 100 coffee cultivators in the following three different villages of Kodai Hills and were asked to respond to each problem :

(i) Pannaikadu (50 cultivators)

(ii) Thandikudi (30 cultivators) and

(iii) Mangalamkombu (20 cultivators).

The list of problems encountered by them are as follows :

P_1- Monsoon failures and unseasonal rains

P_2- Destruction of crops by pests, birds and animals.

P_3- Labour shortage

P_4- High cost of labour, pesticides and fertilizers.

P_5- Difficulties in curing process

P_6- Storage problem

P_7- Unstable selling prices of coffee seeds

P_8- Lack of holding power in case of price decrease

P_9- Unconsistant yield

P_{10}- Low margin of profit.

Description of the Problems

P_1 - Sufficient rain is needed during the period of blossom. Otherwise it will affect the yield. After the period of blossom heavy rains, if any, will wash the flowers and ultimately affect the yield.

P_2 - Pest attack and destruction by wild birds and animals especially monkeys cause damage to the crop.

P_3 - Migration of labour force to urban centres results shortage of labour.

P_4 - Cost of labour increase due to shortage of labour. The price of pesticides and fertilizers are always in the increasing trend.

P_5 - After the raw coffee beans are picked, the process involved in crushing, washing and drying the coffee beans is very difficult.

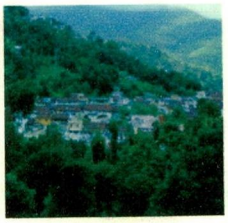
P_6 - Sufficient storage place is needed to store the dried coffee beans till it is sold. But many cultivators do not have the required space.

P_7 - At present there is no standard price for the dried coffee beans. The price is subject to heavy fluctuations depending on the demand in both the National and International markets.

P_8 - In order to meet the financial requirements of domestic expenses and cultivation activities, the cultivators sell at any price and are not in a position to hold the stock expecting a rise in price

P_9 - Due to various factors the yield varies from year to year which cannot be predicted.

P_{10} - The difference between the sales revenue and production cost is marginal.



A Village in the Study Area

Coffee plant

Bunch of Coffee Flowers

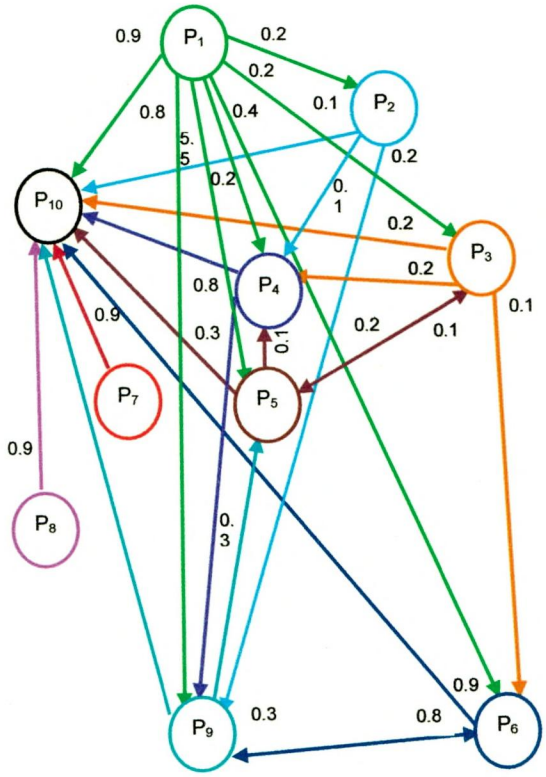
Ripened Coffee Beans

Based on the opinion given by the cultivators on the causal relation between

the problems (nodes), Fuzzy Cognitive Maps were framed for each village. Here the FCM is a weighted directed graph. The weightage for each edge is the ratio between the number of cultivators who opined the existence of causal relation between two nodes and the total number of cultivators.

The Fuzzy Cognitive Maps for each village and associated connection matrices are presented below :

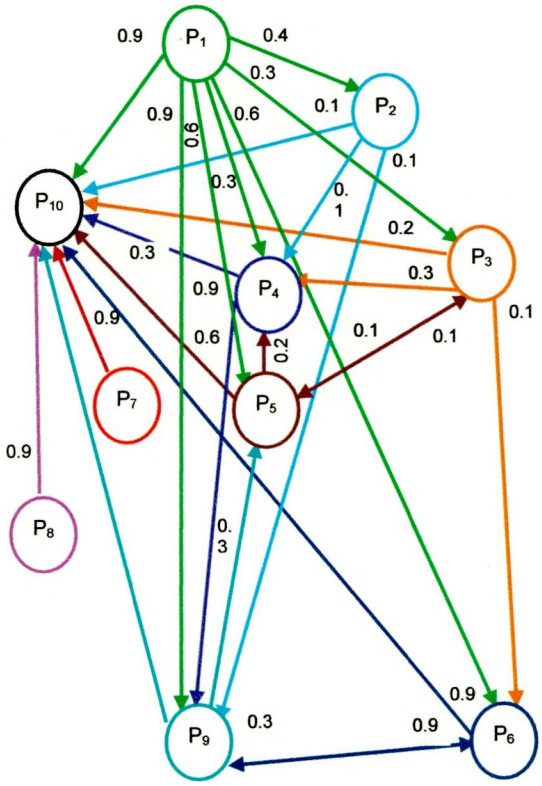
FCM for Village – 1



Associated Connection Matrix M_1

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	0	0.2	0.2	0.2	0.5	0.4	0	0	0.8	0.9
P_2	0	0	0	0.1	0	0	0	0	0.2	0.1
P_3	0	0	0	0.2	0.1	0.1	0	0	0	0.2
P_4	0	0	0	0	0	0	0	0	0.5	0.8
P_5	0	0	0.2	0.1	0	0	0	0	0	0.3
P_6	0	0	0	0	0	0	0	0	0.8	0.9
P_7	0	0	0	0	0	0	0	0	0	0.9
P_8	0	0	0	0	0	0	0	0	0	0.9
P_9	0	0	0	0	0.3	0.3	0	0	0	1
P_{10}	0	0	0	0	0	0	0	0	0	0

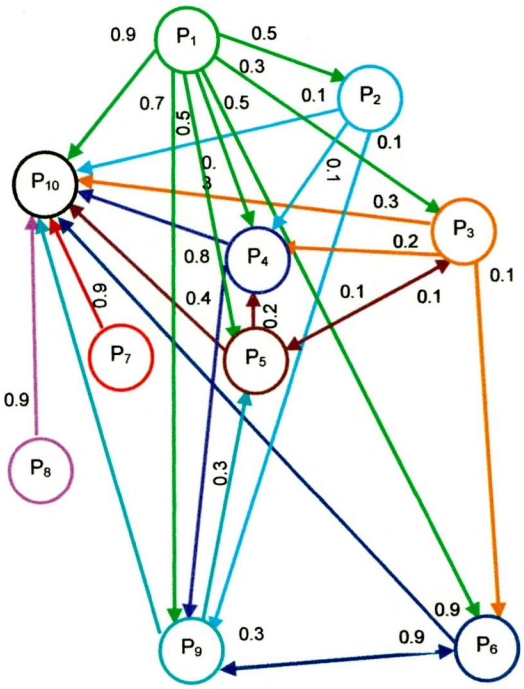
FCM for Village – 2



Associated Connection Matrix M_2

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	0	0.4	0.3	0.3	0.6	0.6	0	0	0.9	0.9
P_2	0	0	0	0.1	0	0	0	0	0.1	0.1
P_3	0	0	0	0.3	0.1	0.1	0	0	0	0.2
P_4	0	0	0	0	0	0	0	0	0.6	0.9
P_5	0	0	0.1	0.2	0	0	0	0	0	0.3
P_6	0	0	0	0	0	0	0	0	0.9	0.9
P_7	0	0	0	0	0	0	0	0	0	0.9
P_8	0	0	0	0	0	0	0	0	0	0.9
P_9	0	0	0	0	0.3	0.3	0	0	0	1
P_{10}	0	0	0	0	0	0	0	0	0	0

FCM for Village – 3



Associated Connection Matrix M_3

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	0	0.5	0.3	0.3	0.5	0.5	0	0	0.7	0.9
P_2	0	0	0	0.1	0	0	0	0	0.1	0.1
P_3	0	0	0	0.2	0.1	0.1	0	0	0	0.3
P_4	0	0	0	0	0	0	0	0	0.4	0.8
P_5	0	0	0.1	0.2	0	0	0	0	0	0.2
P_6	0	0	0	0	0	0	0	0	0.9	0.9
P_7	0	0	0	0	0	0	0	0	0	0.9
P_8	0	0	0	0	0	0	0	0	0	0.9
P_9	0	0	0	0	0.3	0.3	0	0	0	1
P_{10}	0	0	0	0	0	0	0	0	0	0

In order to study the combined effect, the optimal matrix is derived as follows :

The minimal matrix A and the maximal matrix B are obtained using the three matrices M_1, M_2 and M_3. Each entry of the minimal matrix (maximal matrix) is the minimum value (maximum value) of the corresponding entries in M_1, M_2 and M_3.

Then $\overline{M} = \frac{A+B}{2}$ =

	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	0	0.35	0.25	0.25	0.55	0.5	0	0	0.8	0.9
P_2	0	0	0	0.1	0	0	0	0	0.15	0.1
P_3	0	0	0	0.25	0.1	0.1	0	0	0	0.25
P_4	0	0	0	0	0	0	0	0	0.5	0.85
P_5	0	0	0.15	0.15	0	0	0	0	0	0.25
P_6	0	0	0	0	0	0	0	0	0.85	0.9
P_7	0	0	0	0	0	0	0	0	0	0.9
P_8	0	0	0	0	0	0	0	0	0	0.9
P_9	0	0	0	0	0.3	0.3	0	0	0	1
P_9	0	0	0	0	0	0	0	0	0	0

Here we preferred to study only the effect of the problem "P_1-Monsoon failures and Unseasonal rains" on the other problems.

For this purpose, we study the effect of the vector (1 0 0 0 0 0 0 0 0 0) on the optimal matrix $\overline{M}$.

$X\overline{M}$ = (0 0.35 0.25 0.25 0.55 0.5 0 0 0.8 0.9)

after updating and thresholding we get

X_1 = (1 0.35 0.25 0.25 0.55 0.5 0 0 0 0.9)

$X_1\overline{M}$ = (0 0.35 0.25 0.25 0.55 0.5 0 0 0.8 0.9)

after updating and thresholding we get

X_2 = (1 0.35 0.25 0.25 0.55 0.5 0 0 0.8 0.9)

= X_1

which is a fixed point.

Conclusion:

The study revealed that the effect of the problem "Monsoon failures and Unseasonal rains" is 0.35 degree on "Distruction of crops by pests, birds and animals" 0.25 degree on "Labour shortage" 0.25 degree on "High cost of labour, pesticides and fertilizers", 0.55 degree on "Difficulties in curing process", 0.5 degree on "Storage problem", 0.8 degree on "Unconsistant yield" and 0.9 degree on "Low margin of profit", but it has no effect on "Unstable selling prices of coffee seeds" and "Lack of holding power in case of price decrease".

In a similar manner, the effect of each problem on other problems can be derived.