Dynamics of cropping pattern in Karimnagar district of Telangana – A Markov Chain Approach

Abstract: The assessment of shift in cropping pattern in several regions is crucial for a much better insight into the agricultural development method. The present study was undertaken with a view to examine the dynamics of cropping pattern in Karimnagar district of Telangana. The data was collected from Directorate of Economics and Statistics, Government of Telangana from 1966-67 to 2016-17 and it was analysed with the help of Markov chain by decade wise and for last decade, analysed for five periods. The major findings emerged from the study revealed that any set of crops did not retain its area in Karimnagar, but the acreage of the crops was continuously shifting from one set of crops to another set throughout the period. The cereals area was observed to be more stable while the loss of area from cereals towards commercial crops like cotton and turmeric etc. indicated that the cropping pattern of the region moves towards diversification in northern Telangana zone. There is larger scope for deciding within the choice of crops to place the agriculture on the pedestal of property growth that has to be thought-about in analysis and extension programmes.

Keywords: Shift, development, decade, analysis, growth and diversification.

Introduction: The gross cropped area was 356478 ha. whereas net cropped area accounts to 2432023 ha. with cropping intensity of 1.28 in Karimnagar district. The average size of holding is 132439.8 ha. as per the 2010-11 census. The cultivated area was irrigated majorly by dug wells followed by tube wells, tanks and canals by 191446 ha., 44334 ha., 6866 ha. and 122 ha. respectively. Hence, Karimnagar was one of potential districts for agriculture in the state.

Methodology:

Markov Chain Analysis is associate application of dynamic programming to the answer of a random call method. A finite Markoff process could be a model whereby the result of a given trial 't' (t = one, 2, …. T) depends only on the outcome of a preceding

trial (t-1) and this dependence is same at all stages of the sequence of trials (Lee et al., 1965). Consistent with this definition, let the Si represent ith state or possible outcomes; i = 1, 2,...,r , Wit represent the probability that state Si occurs on trial t or proportion observed in trial 't', in alternative outcome state i of a multinomial population based on sample size n, i.e. Pr (Sit). Pij represent the transitional probability which denotes the probability that if for any time t the process is in state Si, it moves on next trial to state Sj,

i.e. $Pr(S_j , t+1 / Sit,) = P_{ij}$

Pr = (Pij) represent shift chance matrix that denotes shift chance for each try of states (i, j = 1,2, ..., r) and has the following properties;

$0 \leq Pij \leq 1$.....(1)

$\sum = nj1 P_{ij} = 1$.....(2)

Given this set of notations and definitions for a first order Markov chain, the probability of particular sequence Si on trial t and Sj on trial t + 1 may be represented by

$Pr (S_{it} , S_j \ t+1 = Pr (S_{it},) Pr (S_j \ t + 1 / S_{it}) = Wit \ P_{ij}$ .... (3)

and the probability of being in state j at trial t + 1 may be represented by

$Pr (S_j \ t-1) = \sum i \ W_{it} \ P_j$ or, $W_j , t+1 = \sum i \ W_{it} \ P_{ij}$ ..... (4)

The data for study is the proportion of area under crops. The crops were grouped into cereals, pulses, oil seeds, commercial crops, fruits and vegetables. The proportion changes from year to year as a result of factors like weather, technology, price and institutional changes etc. It is reasonable to assume that the combined influence of these individually systemic forces approximates to a stochastic process and propensity of farmers to move from one crop to another differs according to the crop state involved. The process of cropping pattern change may be described in form of matrix P of first order transition probabilities. The element P_{ij} indicates the probability of a crop state i in one period will move to crop state j during the following period. The diagonal element Pij measures the probability that the proportion share of ith category of crop will be retained.

Estimation of Transitional Probability Matrix:

Equation (4) can be used as a basis for specifying the statistical model for estimating transitional probabilities. If errors are incorporated in equation (4), it becomes,

$W_{it} = \sum_i$ Badger State t W_i, t - 1 $P_{ij} + U_{jt}$ .....(5) or in matrix type it is written as,

$$Yj=XjPj+Uj \quad \text{.....(6)}$$

Where, Yj = (T * 1) vectors of observations reflecting the proportions in cropping pattern j in time t, Xj =(T * r) matrix of realized values of the proportions in cropping pattern in time t – 1, Pj =(r * 1) vectors of unknown transition parameters to be estimated and Uj = vectors of random disturbances. The data from the period 1966-67 to 2016-17 were collected and compiled from the various reports published by Bureau of Economics and Statistics, Directorates of Economics and Statistics, Government of Telangana, and analyzed for five different periods Viz; Period-I (1966-67 to 1974-75), Period-II (1975-76 to 1984-85), Period-III (1985-86 to 1994-95), Period-IV (1995-96 to 2004-05), period-V (2005-06 to 2016-17) and further the analysis was also carried out for the every five years for the last decade it includes period-VA (2005-06 to 2010-11) and period-VB (2011-12 to 2016-17) by using Markov chain analysis technique. The rationale behind dividing study period into blocks of ten years was to know the change in crops from 1966-67 to 2016-17 and for the last decade the analysis was carried out for every five years considering the agricultural census conducted at an interval of five. While to analyze the data by grouping the crops into various categories becomes the whole task too bulky and difficult.

Results and Discussion: The stability of the acreage share of crop and their direction of change over a period of time was captured by transition probability matrix. As the diagonal elements approaches zero, the crops become less and less stable and as they approach one, they become more and more stable over a period of time. The elements in the i^{th} row (Table 1-3) give the proportions of previous period's acreage of i^{th} crop which is likely to lose to other crops in the current period. The element of i^{th} column gives the proportion of area of i^{th} crop which is likely to gain in the current period.

Table 1: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-I (1966-67 to 1974-75)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.872	0.000	0.125	0.000	0.000	0.002
Pulses	1.000	0.000	0.000	0.000	0.000	0.000
Oilseeds	0.400	0.160	0.409	0.020	0.006	0.006
Commercial crops	0.000	0.000	1.000	0.000	0.000	0.000

Vegetables	0.000	0.000	0.937	0.063	0.000	0.000
Fruits	0.000	0.000	0.149	0.306	0.218	0.327

Table 2: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-II (1975-76 to 1984-85)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.911	0.029	0.059	0.000	0.000	0.001
Pulses	1.000	0.000	0.000	0.000	0.000	0.000
Oilseeds	0.464	0.000	0.465	0.000	0.025	0.045
Commercial crops	0.000	0.000	0.229	0.421	0.000	0.349
Vegetables	0.010	0.000	0.000	0.990	0.000	0.000
Fruits	0.000	0.000	1.000	0.000	0.000	0.000

Table 3: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period -III (1985-86 to 1994-95)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.914	0.005	0.077	0.000	0.003	0.001
Pulses	0.365	0.635	0.000	0.000	0.000	0.000
Oilseeds	0.000	0.000	0.718	0.242	0.020	0.020
Commercial crops	0.540	0.000	0.000	0.460	0.000	0.000
Vegetables	0.000	0.000	0.070	0.000	0.346	0.585
Fruits	0.000	0.000	0.006	0.425	0.000	0.569

Table 4: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-IV (1995- 96 to 2004-05)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.860	0.007	0.034	0.071	0.013	0.015
Pulses	0.000	0.569	0.000	0.117	0.052	0.263
Oilseeds	0.017	0.000	0.468	0.469	0.023	0.023

Commercial crops	0.620	0.000	0.000	0.346	0.004	0.030
Vegetables	0.000	0.239	0.000	0.761	0.000	0.000
Fruits	1.000	0.000	0.000	0.000	0.000	0.000

Table 5: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-V (2006-07 to -2016-17)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.688	0.006	0.034	0.223	0.010	0.038
Pulses	0.974	0.000	0.000	0.000	0.026	0.000
Oilseeds	1.000	0.000	0.000	0.000	0.000	0.000
Commercial crops	0.458	0.010	0.000	0.515	0.000	0.017
Vegetables	0.376	0.394	0.000	0.000	0.230	0.000
Fruits	0.731	0.000	0.197	0.000	0.071	0.000

Table 6: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-VA (2006-07 to 2010-2011)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.694	0.015	0.039	0.199	0.013	0.039
Pulses	1.000	0.000	0.000	0.000	0.000	0.000
Oilseeds	1.000	0.000	0.000	0.000	0.000	0.000
Commercial crops	0.392	0.018	0.013	0.545	0.016	0.016
Vegetables	1.000	0.000	0.000	0.000	0.000	0.000
Fruits	1.000	0.000	0.000	0.000	0.000	0.000

Table 7: Transitional Probability Matrix (TPM) for shift in cropping pattern for Period-VB (2011-12 to 2016-17)

Crops	Cereals	Pulses	Oilseeds	Commercial crops	Vegetables	Fruits
Cereals	0.454	0.002	0.000	0.511	0.004	0.029
Pulses	1.000	0.000	0.000	0.000	0.000	0.000
Oilseeds	1.000	0.000	0.000	0.000	0.000	0.000

Commercial crops	0.948	0.020	0.000	0.000	0.021	0.010
Vegetables	0.570	0.000	0.430	0.000	0.000	0.000
Fruits	0.146	0.057	0.580	0.000	0.000	0.217

Conclusions: The results clearly indicate that 45.4% of cereals area was retained and the remaining area was replaced by commercial crops to an extent of 51.1% and 0.29% by fruit crops and 0.04% by vegetables for the period 2012 to 2017 which clearly indicates the growing trend of commercial crops in Karimnagar district of NTZ. The cereals area was observed to be decreased over the years and it was replaced by commercial crops like cotton and turmeric indicated that the cropping pattern move towards diversification in Karimnagar district of NTZ. Hence, there is greater scope for decision making in the selection of crops to put the agriculture on the pedestal of sustainable growth which needs to be considered in research and extension programmes.

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