COMPETING CROPS AND SHIFT IN AREA
CHAPTER 2

COMPETING CROPS AND SHIFT IN AREA

2.0 Summary

Competing crops are defined to be those crops which directly or indirectly affect the area allocation. To identify the competing crops among a group of crops, it is necessary to find out acreage responses. A statistical method has been described for this purpose. During a season, a group of crops may have positive or negative growth rates. It is noted that net sown area contributes to growth rates. After eliminating the effect of net sown area, effects of individual crop have to be considered to find out a shift in area from one group of crops to other. A stable crop in view of acreage over the years has been identified for Kharif and rabi season.

2.1 Introduction

In case of regression analysis technique, proper choice of explanatory variables (independant) for a selected dependant variable is an important task. Nerlovan (1958) used acreages of competant crop for a selected crop as explanatory variable in his distributed lag model for describing the acreage response of major crops in Maharashtra. Pawar (1994) used relative prices of competant crops to find out the acreage response.

The problem of identifying competant crops within a group of crops is an important one. Once we find competant crops, the problem of shifting of an area from one crop to another or from a group of crops to other group can be solved.

The shifting of area from one crop to other may be due to rainfall, prices of the agricultural produce, introduction of new varieties, available market facility for selling agriculture produce, irrigation facility etc. In order to forecast area of a particular crop, the statistician has to study its historical background. Before ascertaining causes responsible for changes in cropping pattern, their
requirements have to be established by valid measure. The existence, direction and extent of such changes have to be considered.

Ramasubhan (1963) identified two kinds of changes i.e. Shift and Deviation and suggested the rank correlation as a measure to assess shifts. But the ranking of cropping pattern is a crude measure and may not give a true picture. Parametric measure may give accuracy than Nonparametric measure. So it is decided to use an exponential model $Y = Ab^t$ to find out compound growth rates of crop acreages. After eliminating effect of growth due to net sown area, actual growth of crops acreage yields true picture of shift and deviation of acreages of different crops. Percent shift of acreages from one group of crops and percentage shifts of acreages received to other group has been identified and presented graphically.

2.2 The Method of finding competing crops:-

From the definition of competent crops it is felt that a group of crops should have the same season that is kharif or rabi or summer etc. To test whether a crop is competing with a selected crop, the Pearson’s Co-efficient of correlations and Regression Coefficients are used.

The procedure formulated is as follows,

A. Collect information of acreages on major crops.
B. Classify the crops as per the season i.e. kharif, rabi, summer etc.
C. Obtain correlation coefficients of acreages for the group of crops having the same period.
D. Identify negatively correlated crops among the group.
E. Build up a multiple regression model, assuming that crop acreages are independant.
2.2.1 Regression Technique:

The regression analysis is a mathematical measure of average relationship between two variables. A line of regression of $y$ on $x$ is given by $y = a + bx$, where

- $y$ = dependant variable, $a$ = constant
- $b$ = regression coefficient, $x$ = independant variable

**Multiple regression**

In the above model when the number of independent variables are more than one, the model is called multiple regression model is defined as follows

$$y_t = \alpha + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \ldots + \beta_n x_{nt} + \varepsilon_t$$

where

- $y_t$ - Dependant variable,
- $x_{1t}, x_{2t}, x_{nt}$ - Independant variables,
- $\alpha$ - Constant, $t$ - time/period,
- $\beta_1, \ldots, \beta_n$ - regression coefficients,
- $\varepsilon_t$ - error distributed as $N(0, \sigma^2)$.

Using the principle of least square, we estimate $\alpha_i, \beta_i$. Now suppose that there are $n$ crops within a subgroup or season, among which $m$ are negatively correlated as defined in step D of the procedure above. Define regression model as,

$$Y_{jt} = \alpha_j + \sum \beta_k x_{kt} + \beta_{m+1} Y_{j(t-1)} + \varepsilon_{jt}$$

for $j = 1, 2, 3; \quad n = 1, 2; \quad m = \text{period}$

where,

- $Y_{jt}$ - Acreage of selected crop ($j^{th}$) for which competing crops are to be found out
- $X_{kt}$ - Acreages of negatively correlated crops with selected crops
- $Y_{j(t-1)}$ - Laged Acreage of selected crop for which competing crops are to be found out
\( \alpha_j \) - constant for \( j = 1,2 \) \( n \)

\( \beta_i \) - Regression Coefficient of each negatively correlated crops.

\( i = 1,2, \) \( m \)

\( \beta_{m+1} \) - Regression coefficient of laged acreage of selected crop.

\( e_{jt} \) = errors distributed as \( N(0, \sigma_e^2) \)

Hypothesis under study is to test

\( H_0 \) \( \beta_1 = \beta_2 = \beta_3 = \beta_m = \beta_{m+1} = 0 \) Vs

\( H_1 \) \( \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_m \neq \beta_{m+1} \neq 0 \)

The t test statistic has been used to test the significance of regression coefficient

\[
\frac{t_{cal}}{error \ d \ f} = \frac{\text{Regression coefficient}}{S \ E \ of \ Regression \ coefficient}
\]

If \( |t|_{cal} > t_{tab} \), reject \( H_0 \) at 5% level of significance

otherwise accept \( H_0 \) at 5% level of significance

F. Results:

For \( \beta_1, \beta_2, \beta_3 \) \( \beta_m \)

Rejection of \( H_0 \) implies that the crop is truly competant with selected crop whose competant crop is to be found out

Acceptance of \( H_0 \) implies Crop is not competant
For $\beta_{m+1}$

Rejection of $H_0$ implies the farmers are preferring the same crop to sow again and not shifting towards other.

Acceptance of $H_0$ implies area has shifted towards other crop.

2.3 ILLUSTRATION

For an illustration, Ahmednagar district in Maharashtra has been selected. In this district, the major seasons are Kharif, Rabbi, and Summer. The seasons Kharif and Rabbi have been selected for the study. During Kharif season, the major crops have been identified. The crops sown in the month of June-July are Bajra, Kharif Jowar, Tur, K- Gnut, Mung, Rice, Sugarcane. During Rabbi season, the major crops that is, crops sown in October-November have been identified and are Rabbi Jowar, Wheat, Gram, Safflower, and Sugarcane. Observe that Sugarcane is the crop for both seasons. For this crop, area can be shifted during both the seasons.

The data of acreages for different crops of the district have been collected from Seasons and Crop reports, Epitome Part II, Department of Agriculture, Govt of Maharashtra publication for the year 1960-61 to 1990-91. Data for 31 years have been used for analysis.

For Kharif season, Karl Pearson’s Coefficient of correlations were computed and negatively correlated crops have been identified for each area, because $-ve$ correlation implies shift of an area between the crops.

The selected crops and their negatively correlated crops for Kharif season are described in Table 2.1.
Table 2.1: Correlation Matrix For Kharif Crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>BAJRA</th>
<th>KHARIF</th>
<th>TUR</th>
<th>MUNG</th>
<th>RICE</th>
<th>SCANE</th>
<th>GNUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAJRA</td>
<td>*****</td>
<td>- 065</td>
<td>+ 661</td>
<td>+.344</td>
<td>-.032</td>
<td>+ 004</td>
<td>+ 071</td>
</tr>
<tr>
<td>K JOWAR</td>
<td>-.065</td>
<td>*****</td>
<td>- 096</td>
<td>- 416</td>
<td>+ 168</td>
<td>+ 774</td>
<td>- 435</td>
</tr>
<tr>
<td>TUR</td>
<td>+ 661</td>
<td>- 096</td>
<td>****</td>
<td>+.758</td>
<td>+ 553</td>
<td>- 218</td>
<td>+ 225</td>
</tr>
<tr>
<td>MUNG</td>
<td>+ 344</td>
<td>- 416</td>
<td>+.758</td>
<td>****</td>
<td>+.575</td>
<td>-.539</td>
<td>+ 361</td>
</tr>
<tr>
<td>RICE</td>
<td>- 032</td>
<td>+ 168</td>
<td>+ 553</td>
<td>+.575</td>
<td>****</td>
<td>-.078</td>
<td>+ 291</td>
</tr>
<tr>
<td>S’CANE</td>
<td>+ 004</td>
<td>774</td>
<td>- 218</td>
<td>- 539</td>
<td>-.078</td>
<td>****</td>
<td>- 253</td>
</tr>
<tr>
<td>G’NUT</td>
<td>071</td>
<td>- 435</td>
<td>+ 225</td>
<td>+ 361</td>
<td>+.291</td>
<td>-.253</td>
<td>****</td>
</tr>
</tbody>
</table>

Observed Kharif crops and their negatively co-related crops from table 2.1 are as under

Kharif crop selected | Negatively Correlated crop
1. Bajra              | Kh. Jowar, Rice
2. Kh Jowar           | Tur, Mung, G’Nut, Bajra
3. Tur                | Kh Jowar, S’cane
4. Mung               | Kh Jowar, S’Cane
5. Rice               | Bajra, S’cane
6. Sugarcane          | Tur, Mung, Rice, G’Nut
7. Groundnut          | Kh Jowar, S’cane

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The Correlation Matrix is presented in table-2.1. Using multiple regression model defined in 1.2, in addition to negatively correlated crops, laged acreage of selected crop has been added as a explanatory variable for each selected crop whose competing crop is to be found out. As there are 7 crops selected for Kharif season, 7 regression equations are constructed. The ‘t’ values for each regression coefficient are presented in Table-2.2.

Results show that only Kh Jowar and Mung are competent crops. These are negatively correlated and regression co-efficients are differing significantly, \( t = -2.42^{**} \). For almost every other crop, farmers prefer to sow the same crop every year that is the coefficient of laged variable is differing significantly For eq No 2 and 6 the for Kh Jowar and Sugarcane the Regression coefficient of Tur is +ve and significant which implies that, Tur area supports that of Kh Jowar and Sugarcane acreages. The result shows that only significant shifting of an area is from Mung to Kh Jowar. The results have confirmed the shift in area.
### TABLE 2.2: \( T \) VALUES FOR KHARIF AREA

<table>
<thead>
<tr>
<th>Eq no</th>
<th>INDEPENDENT ( \rightarrow ) DEPEND</th>
<th>BAJA/ LAG BAJA</th>
<th>KJOWA/ LAG KH JOWAR</th>
<th>TUR/ LAG TUR</th>
<th>GNUT/ LAG GNUT</th>
<th>MUNG/ LAG MUNG</th>
<th>RICE/ LAG RICE</th>
<th>SCANE/ LAG SCANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BAJRA</td>
<td>143</td>
<td>-23</td>
<td>147</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KH JOWAR</td>
<td>6960**</td>
<td>2770**</td>
<td>-1670**</td>
<td>-242**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TUR</td>
<td>030</td>
<td>376**</td>
<td>460</td>
<td>590**</td>
<td>72**</td>
<td>-46</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MUNG</td>
<td>460</td>
<td>590**</td>
<td>578**</td>
<td></td>
<td></td>
<td>-162</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RICE</td>
<td>47</td>
<td>578**</td>
<td>578**</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SCANE</td>
<td>-1490</td>
<td>120</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>GNUT</td>
<td>-1490</td>
<td>147</td>
<td>147</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*, ** Significant at 5, 1 % respectively

For rainy season five crops were identified, simple correlations were computed and results are presented in table-2.3
### Table 2.3: Correlations matrix for Rabbi Crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>SCANE</th>
<th>WHEAT</th>
<th>GRAM</th>
<th>R JOWAR</th>
<th>SAFFFLOWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCANE</td>
<td>****</td>
<td>+.649</td>
<td>+.160</td>
<td>- 399</td>
<td>+.659</td>
</tr>
<tr>
<td>WHEAT</td>
<td>+ 649</td>
<td>****</td>
<td>+ 385</td>
<td>- 296</td>
<td>+ 463</td>
</tr>
<tr>
<td>GRAM</td>
<td>+ 160</td>
<td>+ 385</td>
<td>****</td>
<td>-.120</td>
<td>+ 342</td>
</tr>
<tr>
<td>R JOWAR</td>
<td>- 399</td>
<td>-.296</td>
<td>- 120</td>
<td>****</td>
<td>+ 007</td>
</tr>
<tr>
<td>SAFFFLOWER</td>
<td>+.659</td>
<td>+ 463</td>
<td>+.342</td>
<td>+ 007</td>
<td>****</td>
</tr>
</tbody>
</table>

Selected crops for Rabbi season and their negatively correlated crops are as under.

<table>
<thead>
<tr>
<th>Rabbi selected crops</th>
<th>Negatively correlated crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1   Rabbi Jowar</td>
<td>Sugarcane, Wheat, Gram</td>
</tr>
<tr>
<td>2   Wheat</td>
<td>Rabbi Jowar</td>
</tr>
<tr>
<td>3   Sugarcane</td>
<td>Rabbi Jowar</td>
</tr>
<tr>
<td>4   Gram</td>
<td>Rabbi Jowar</td>
</tr>
<tr>
<td>5   Safflower</td>
<td>-------</td>
</tr>
</tbody>
</table>

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Using the multiple regression model defined in 2.2, it is noted that the acreages of the crop are negatively correlated with the crop acreage of selected, crop. The competent crop has to be found out where lagged acreages of selected crops are taken as explanatory variables. It is observed that there is no crop whose acreage is negatively correlated with Safflower crop acreage. So, as there are only four crops whose competing crop is to be found out, four regression equations are defined. The ‘t’ values of each regression co-efficient for each equation as defined in 2.2.1 are presented in table 2.4.

**Table 2.4: t Values for Rabbi Area**

<table>
<thead>
<tr>
<th>EQ No</th>
<th>INDEPENDENT</th>
<th>DEPENDANT</th>
<th>R/JOWAR</th>
<th>LAG R/JOWAR</th>
<th>SCANE</th>
<th>LAG SCANE</th>
<th>WHEAT</th>
<th>LAG WHEAT</th>
<th>GRAM</th>
<th>LAG GRAM</th>
<th>SAFFLOW</th>
<th>LAG SAFFLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R JOWAR</td>
<td>1.18</td>
<td>-.105</td>
<td>-</td>
<td>-.25</td>
<td>.02</td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WHEAT</td>
<td>-1.40</td>
<td>5.44**</td>
<td>8.63**</td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SCANE</td>
<td>-2.83**</td>
<td>8.63**</td>
<td>------</td>
<td></td>
<td></td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>GRAM</td>
<td>-1.14</td>
<td>------</td>
<td>------</td>
<td>5.96**</td>
<td></td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SAFF</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>5.96**</td>
<td>------</td>
<td></td>
<td>------</td>
<td></td>
<td>--------</td>
<td></td>
</tr>
</tbody>
</table>

*, ** Significant at 5, 1% respectively.
It is observed from table 2.4 that in the regression equation 3 that is for the crop Sugarcane, the regression coefficient of the crop Rabbi Jowar is differing significantly with negative sign that is \( t = -2.83** \). This implies that Sugarcane and Rabbi Jowar are competing crops. For other crops which are Wheat and Sugarcane, ‘t’ values for lag variables are 5.44** and 5.96** respectively. Those are significant at 5% and 1% level of significance. This means that the farmers are not ready to change the cropping pattern of Wheat and Sugarcane. On the other hand, as the area of Sugarcane increases the area of Rabbi Jowar decreases. This shows that Rabbi Jowar area has been shifted towards the Sugarcane.

2.4 Shift in Area

The Exponential growth function has been used to describe a shift in Area from one crop to the other crop, or a group of crops to the other group of crops. In analysis of variance technique the total variation is distributed or splitted in various factors, similarly the total growth in area of a crop is partitioned as

Total growth in area = Growth due to Increase in Net sown area + Growth due to Individual Crop area increase

Let \( G = g1 + g2 \)

That is \( g2 = G - g1 \) \( \ldots 1 \)

Shift in area is defined on the basis of \( g2 \)

Defn - The exponential growth curve is defined as \( Y = \alpha e^{\beta t} \)

where \( t \) is time period, taking logarithm from both sides

\[ \log Y = \log \alpha + t \log \beta \]

Parameters can be estimated using least square technique

% compound growth rate \( r = (\beta - 1) \times 100 \)

Let us define exponential growth function for each factor
1. For total growth in area

Suppose there are n crops, under study.

Let \( r_i \) \( i = 1,2, \ldots, n \) be the compound growth rate of \( i^{th} \) crop. Define the function

\[
Y_i = \alpha_i \beta_i^t, \quad i = 1,2, \ldots, n
\]

\[
\log Y_i = \log \alpha_i + t \log \beta_i
\]

\[
\% r_i = (\beta_i - 1) * 100 \quad i = 1,2,3, \ldots, n
\]

2. For growth due to net sown area,

Define \( Y = A^t \beta^t \)

\[
\log Y = \log (A) + t \log \beta
\]

\[
\% R = \text{Percent Compound growth rate for net sown area}
\]

from eq 1. \( g_2 = G - g_1 \)

\[
\% G R \quad \text{in individual crop area increase} = r_i - R
\]

We test hypothesis

\[
H_0: r_1 = r_2 = r_3 = r_4 = \ldots = r_n = R
\]

Vs \( H_1: r_1 \neq r_2 \neq r_3 \neq \ldots \neq r_n \neq R \)

Define test statistics for \( i = 1,2,3, \ldots, n \) crops.

\[
r_i - R > 0
\]

\[
r_i - R < 0
\]

\[
r_i - R = 0
\]

\( r_i - R > 0 \) Implies that Area has been shifted towards \( i^{th} \) crop (Reject \( H_0 \))

\( r_i - R < 0 \) Implies that Area has shifted from \( i^{th} \) crop to other crops (Reject \( H_0 \))

\( r_i - R = 0 \) Implies that No shifting in area (Accept \( H_0 \))

Identify the crops for which \( (r_i - R) > 0 \) and \( (r_i - R) < 0 \). The groups of crops are formed on the basis of \( (r_i - R) > 0 \) or \( (r_i - R) < 0 \). The group of crops for which \( (r_i - R) < 0 \) implies that area has been shifted from this group of crops and the group for which \( (r_i - R) > 0 \) implies that area has shifted to this group of crops
Assuming that, total area shifted from the group of crops to the other group is 100 percent, Cropwise Percent proportions of shifting of an area from the crop to the other crops are computed, and the results are presented graphically

2.5 ILLUSTRATION

For an illustration the data of Ahmednagar district which is utilized for the competing crops model, have been used. In addition to acreages the data of net sown area has been collected. The net sown area has been computed by adding the acreages of all major crops within season.

For Kharif, the crops Bajra, Kh Jowar, Tur, Mung, Rice, Sugarcane and Groundnut are considered whereas for rabi Sugarcane, Wheat, Gram, Rabri Jowar, Safflower are considered.

For Kharif percent compound growth rates are computed by fitting the exponential function.

\[ Y_t = \alpha \beta^t \quad t = 1, 2, 3 \quad 7 \text{ for time } t = 31 \text{ years for each crop.} \]

The results are presented in Table 2.5

<table>
<thead>
<tr>
<th>CROP Kharif</th>
<th>PERCENT COMPOUND GR</th>
<th>G.R - GR (N.S.A)</th>
<th>% SHIFITNG TO KH. JOWAR &amp; SCANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAJRA</td>
<td>250312</td>
<td>-1241</td>
<td>7000</td>
</tr>
<tr>
<td>KH JOWAR</td>
<td>1329218</td>
<td>11801</td>
<td>-----</td>
</tr>
<tr>
<td>TUR</td>
<td>-157742</td>
<td>-3068</td>
<td>17.4</td>
</tr>
<tr>
<td>MUNG</td>
<td>-648983</td>
<td>-7.981</td>
<td>45.2</td>
</tr>
<tr>
<td>RICE</td>
<td>-1.53804</td>
<td>-3029</td>
<td>17.2</td>
</tr>
<tr>
<td>SCANE</td>
<td>2265276</td>
<td>774</td>
<td>-----</td>
</tr>
<tr>
<td>GNIUT</td>
<td>-84639</td>
<td>-2337</td>
<td>13200</td>
</tr>
<tr>
<td>NET SOWN AREA</td>
<td>1491006</td>
<td>000</td>
<td>-----</td>
</tr>
</tbody>
</table>
From the table 2.5 it is observed that Percent compound growth rate is lowest that is -6.4898 for the crop Mung. While it is highest that is 13.2922 for the crop Kharif Jowar. The percent compound growth rate for net sown area is 1.491. After subtracting 1.491 from each percent compound growth rate of kharif crops the signs of resultant growth rates were observed. For kharif Jowar and Sugarcane signs are positive while for all other crops signs are negative.

Assuming that growth in net sown area has distributed equally to all crops, + ve sign implies that Crop area has shifted towards Kharif Jowar and Sugarcane.

-ve sign implies that Crop area has shifted from other crop i.e. Bajra, Tur Mung, Rice, Groundnut.

Assuming that total percentage shifting of area from one group of crops towards other group is 100 percent. Percentages has computed and presented graphically. Observed that in Kharif maximum percent area is shifted towards Kharif Jowar that is 93.84 percent and second towards Sugarcane i.e. 6.16 percent. While maximum percent area shifted from Mung 45.2 percent and others are Tur 17.4 percent, Rice 17.2 percent, Groundnut 13.2 percent, Bajra 7.00 percent. The results are depicted in Fig 2.1. The conclusions are similar as drawn earlier in 2.3.

For rabbi season percent compound growth rates have computed by fitting exponential model i.e. \( Y_t = \alpha_i e^{\beta_i t} \) for \( i = 1,2 \), 5 crops and over the period \( t \). Results are presented in table 2.6.
Table 2.6: RESULT OF SHIFT IN AREA FOR RABBI CROPS

<table>
<thead>
<tr>
<th>CROPS RABBI</th>
<th>% COMPOUND G.R.</th>
<th>G.R -G.R(N S.A)</th>
<th>% SHIFTING SCANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCANE</td>
<td>2 265</td>
<td>041</td>
<td>0 00</td>
</tr>
<tr>
<td>WHEAT</td>
<td>1 959</td>
<td>-.265</td>
<td>6 078</td>
</tr>
<tr>
<td>GRAM</td>
<td>1 674</td>
<td>- 551</td>
<td>12 606</td>
</tr>
<tr>
<td>RJOWAR</td>
<td>- 31</td>
<td>-2 534</td>
<td>58 024</td>
</tr>
<tr>
<td>SAFF</td>
<td>1 207</td>
<td>-1 017</td>
<td>23 292</td>
</tr>
<tr>
<td>NET SOWN AREA</td>
<td>2 224</td>
<td>0 00</td>
<td>0 00</td>
</tr>
</tbody>
</table>

It is observed from the table 2.6 that percent compound growth rates are positive for all crops except Rabbi Jowar. Percent compound growth rate is maximum for Sugarcane that is 2 265 and minimum for Rabbi Jowar i e - 31. Percent compound growth rate for net sown area is 2 224 assuming that the growth in net sown area has distributed equally to all crops. Percent compound growth rate of net sown area was subtracted from each crops percent compound growth rate. It is observed that only the crop sugarcane had positive sign and all other crops are had negative sign. Which implies that the area has shifted towards Sugarcane from other crops that is from Wheat, Gram, Rabbi Jowar, Safflower.

Assuming total percent shifting of area from one group of crops towards other group is 100 percent, it is observed that maximum 58 024 percent R Jowar area has been shifted towards sugarcane and minimum shift in area is from wheat 6 078 percent. The conclusions are similar as drawn earlier in 2 3. The results are depicted graphically in fig 2 2.
2.5.1 Ranking of crops

Ranking the crops on the basis of the percent shift in area will give us first competent, second competent third competent crops etc. within a season that is for Kharif, Rabbi etc. For Kharif and Rabbi season results are as under:

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Kharif season</th>
<th>Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mung</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Tur</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Rice</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>G’nut</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Bajra</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Rabbi season</th>
<th>Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R Jowar</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Safflower</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Gram</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Wheat</td>
<td>4</td>
</tr>
</tbody>
</table>

2.6 Stability

The stability of the crop over the year in view of acreages is define on the basis of percent shift in area

Define
- Minimum percent shift implies Stable crop
- Maximum percent shift implies Unstable crop

For Kharif, Bajra is identified as stable crop having rank 5 and Mung as mose unstable crop ranking 1 for Ahmednagar district

For Rabbi, Wheat is identified as most stable crop ranking 4 and Rabbi Jowar as unstable ranking 1 for Ahmednagar district. So we can say that top ranking crops are most unstable and least rankers are stable crops over the period.
PERCENT AREA SHIFTED TO K-JOWAR AND SCANE FROM OTHERS

13.2 7
17.2
45.2

Fig 2.1

PERCENT SHIFT IN AREA TO SCANE FROM OTHER RABBI CROPS

23.29 6.08 12.61
58.02

Fig 2.2