Chapter-4

CHANGING PATTERN OF CROPS AFTER THE INTRODUCTION OF GREEN REVOLUTION

The study of cropping pattern involves the description of area under various crops and changes therein during a certain period of time which gives a clue to understand the option preferred by farmers. The cropping pattern varies from region-to-region in the area in space and time due to interplay of physico-cultural and technological factors. Appendix presents the percentage area under some important crops. It reveals that wheat predominates over all other crops and the magnitude of area of wheat has increased. In 1995-96 it covered 35.4 percent while 1999-2000 it registered about 36.58 percent. It is significant to note that area under sugar cane is constantly decreasing and it registered a rate of 7.89 percent during the period of 1975-80. In 1975 it covered an area of about 22200 hectare and in 1999-2000 it decreased about 12882 hectare. The area under potato has also increased to about 180 per cent and the area under paddy has also rose to about 65.16 percent the area under maize grew up to 6.42 percent in 1975-76 and in 1999-2000 reached to 11.35 percent. This result amply suggests that cropping pattern is changing in the district, and shift from cereal to cash crops potato and high yielding varieties of cereals such as wheat and paddy. These variations have their genesis in the human choice to grow the crops for monetary gain and the facilities easily available to the farmers. The block wise analysis of the cropping pattern indicates that the area under different crops also exhibits almost the same patterns with few exceptions. The percentage
of area under rice cultivation in most of the block cropping pattern generally reveals the spatial adjustment of crops among themselves in a given point of time according to prevailing conditions. Change in cropping pattern is a significant feature in the agriculture landscape of a region. The region lying between the two great rivers of India the Ganga and the Yamuna is one of the most fertile and thickly populated part of the state Uttar Pradesh where about 80% of the cultivated land is occupied by grain crops which are largely grown for domestic consumption. The District Etah under study is a part of the Ganga-Yamuna doab. This region (Ganga-Yamuna doab) enjoys the highest level of agricultural efficiency in the whole of Uttar Pradesh. Etah has evolved its own cropping pattern practice depending upon the suitability of soil, climate of the region and food habit of its population, the alluvial type of soil and adequate irrigation facilities. Nearly 75 percent of the cultivated land is devoted to the grain crops and rest 25 percent covered by other crops i.e. cash and non-cereal both.

The main objective of the research is to systematize and improved understandings of the change induce in the pattern of crops land use. The focus of interest broadly involves a dual effort just defining the basic geography of change and its behavior in terms of rates of acceleration and deceleration, and secondly, a search for the types of factors that have set the discoursed changes in motion. In a very real sense of course, individual crops in any agricultural area in a state is of essential competition one with another for the favours of the farmer and for a place on his land.

**EXPANSION OF CULTIVATION:**

Land use is perhaps the most basic concept of agricultural economy. It is the key to an understanding of geographic adjustment of the agricultural resources. Moreover, regional land use patterns are,
after all the geographical expression of a large number of societal decisions made at different times for often very different reasons, which are responsible for the expansion of one category of land use at the cost of other. The introduction of Green Revolution has reached its limit to the expansion of cultivated land. The district Etah reached almost the physical frontiers in matter of expansion of area under cultivation during the period 1970 to 1999 when the cultivated area increased from 70.01 per cent to 80.85 per cent. Thereafter, the increase in cultivated area is insignificant as data (Appendix-1) highlights the facts, that we can not look to more lands to meet the increasing demands of food in the future, as over-major spread of the district the proportion of cultivated area is over 85 per cent. This percentage strength that is very high, when compared with the state average of about 68.96 per cent. Within the district, there are no wide differences from one region to another in the cultivated area, because district Etah is one of the most cultivated districts of U.P. The face of the district have been described as a carpet of tillage fields. High proportions of cultivated area (over 70 percent) cover a major spread of the district Etah as against lower one (under 70 per cent) covering only the tarai tract and salt affected (user land) stretches in the south and South-West block of the district. The high proportion owe to first, the alluvium sandy loam and loamy sand agricultural lands Second, easily workable alluviums having excellent irrigation facilities in the old and newly irrigated areas.

**HARVESTED CROPLAND:**

The extension of cultivation is not a matter of significance at present, except for achieving local gains. Intensity of cropping, extent of maturity and increase of the yield from the existing cultivated area are problems of paramount importance in the agricultural economy of India. It would be useful to overcome these problems in the
foreseeable future to analyses the changes in the cropping pattern. Hence, it is imperative to investigate the degree of efficiency with which the net area sown is utilized.

Table-4.1

CROPPING INTENSITY IN DISTRICT ETAH

<table>
<thead>
<tr>
<th>Development Block</th>
<th>1975-76</th>
<th>1999-2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marehra</td>
<td>172.65</td>
<td>180.8</td>
</tr>
<tr>
<td>Nidhauri Kalan</td>
<td>148.31</td>
<td>167.9</td>
</tr>
<tr>
<td>Sheetal pur</td>
<td>156.71</td>
<td>178.74</td>
</tr>
<tr>
<td>Sakeet</td>
<td>145.18</td>
<td>155.44</td>
</tr>
<tr>
<td>Sahawar</td>
<td>145.61</td>
<td>218.69</td>
</tr>
<tr>
<td>Sirpura</td>
<td>148.87</td>
<td>179.40</td>
</tr>
<tr>
<td>Kasganj</td>
<td>186.106</td>
<td>183.74</td>
</tr>
<tr>
<td>Amanpur</td>
<td>168.93</td>
<td>206.59</td>
</tr>
<tr>
<td>Soron</td>
<td>153.67</td>
<td>199.18</td>
</tr>
<tr>
<td>Aliganj</td>
<td>133.92</td>
<td>160.56</td>
</tr>
<tr>
<td>Ganj Dundwara</td>
<td>116.31</td>
<td>139.31</td>
</tr>
<tr>
<td>Jaithra</td>
<td>143.34</td>
<td>169.75</td>
</tr>
<tr>
<td>Patiala</td>
<td>121.99</td>
<td>157.8</td>
</tr>
<tr>
<td>Jaleasr</td>
<td>149.07</td>
<td>148.28</td>
</tr>
<tr>
<td>Awagarh</td>
<td>140.31</td>
<td>167.96</td>
</tr>
</tbody>
</table>

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Cropping intensity means the land use efficiency, is definable as the degree to which the net area sown is cropped or resown. The total cropped area as a percentage of the net area sown gives a measure of land use efficiency, which really means the intensity of cropping. The intensity of cropping refers to the number of crops raised on a field during an agricultural year. For example, if one crop is grown on a field either as a Kharif or as a Rabi crop in a year, the index of cropping is 100 per cent and it can be farmed as single cropping. If two crops in a year are procured as Kharif and Rabi crops, the intensity index will be 200 per cent and such case can be designated as double cropping; if three crops in a year are produced as Kharif, Rabi and Zaid rabi the intensity of cropping will be 300 per cent and it will be a case of multiple cropping. Therefore, higher the index of cropping intensity higher is the land use efficiency and vise-versa. In densely populated country intensification proceeds mechanization but converse is the case in the context of district Etah. Although district Etah is a part of Ganga plane the geography of its agriculture is exceedingly complex. It is accentuated by the impact of continued irrigation development and state intervention in agriculture. The years between 1975 and 2000 witnessed major changes in the agricultural land use in India in general, Etah in particular because of the expansion of irrigation facilities and launching new agricultural strategy. The extension of irrigation from canals and tube-wells along-with adoption of modern form of technology by the assiduous receptive farming commodities improved the agricultural progress. Still there are 'poor areas' in the agricultural economy of the district Etah where the magnitude of land use efficiency or intensity of cropping is 139 percent, as in these sectors only less than 39 per cent of the net area sown is recropped during an agricultural year.

In district Etah, the land with assured irrigation facilities and good quality of soil can bear two or three crops in a year, provided the fields are
carefully cultured. Extent of crops sown in an area in any agricultural year is more than the net area sown. A successful season of monsoon is the controlling factor for the intensity of cropping in the region under study, but in rain fed areas particularly. The most district explanations of the variation in the aerial distribution of cropping intensity index have of course, reference to the effect of irrigation intensity, cultivator's density, the nature of soil, the rainfall characteristic and the size of operational holdings. All over the district Etah, the total cropped area exceeds the net area sown because there always is a part of later. Which sown during both the crop season. The cropping intensity index in the district varies from 139 to over 218 per cent exhibiting a great regional disparity (Table 4.1).

Three categories have been identified in figure-4.2 and for the purpose of discussion these have been grouped into three regions comprising the areas of low intensity indexes (under 165 percent), areas of medium intensity index (165 to 192 percent) and areas of high to very high intensity index (above 192 percent). Areas of low intensity indexes are those that have poor irrigation facilities, limited surface water, decreasing water table salt ridden water (in Jaleser and Skeet) influents and water pouring due to poor drainage system impose restrictions on the extension of double as well triple cropped areas. It is quite obvious that a second Rabi crop in the same field cannot follow a kharif crop if there is a soil moisture deficit. On the other hand moisture is excessive as may happen in the Katery area; the soil might suffer, making it difficult to plough the field for rabi crops. The area of low intensity is Patiali, Aliganj and Sakeet where two factors play major role, i.e. salinity of the soil (usar land) and the development of Katery (due to pouring of water). The areas of high and very high indexes are confined to the development blocks which have tube-well irrigated fertile soil and availability of mechanical appliance, e.g. Sahawar, Amanpur and Soron. The development of improved soil drainage
and the availability of mechanical power have enabled much of the heavy level to be more intensively cultivated. On the whole, high and very high intensities are observed in areas having fertile loamy soils developed irrigational facilities or favourable rainfall. Elsewhere, the intensity index is moderate because of restrictions imposed on cropping by the fluctuation in the supply of agricultural water.

The changes in the extent of the double-cropped area are mainly because of expansion of canal and tube-well irrigation and the exceptionally high growth of rural population and process of settlement. Besides these two vital influents, the growing of cash crops the degree of workability and fecundity of the soil, the size of operational holdings and the initiative of the peasant are some other factors in determining the changes. The discernible annual fluctuation in the double-cropped area is due to annual variation in the amount and distribution of rainfall and canal discharges the long-term changes are associated with the changes in the intensity of irrigation, the agricultural population and form technology over the same period. A comparison of figure 4.1 And 4.2, highlights the outstanding changes in the intensity of cropping during the period under review.

**TREND IN CROPPING PATTERN:**

Wheat is the most important cereal consumed by millions all over the world. It is the premier crop of the state and the staple food of the people living in the whole western U.P. The Etah district produces 2.45 per cent of the state total quantity of wheat and 2.25 Per cent of the total cultivated area of the state lies under wheat in the district Etah. All the development blocks of the district are provided with the best type of soils for the growth of this crop. Wheat is the first ranking crop of all the blocks in the area under study. In the block of Nidhauli Kalan wheat occupied 39.134 per cent of the gross cropped area of the block or 11842 hectare
during the period of 1975-76. Wheat becomes a crop of first rank during the same period. During the period of 1980-81 the total cultivated area under wheat increased from 11842 hectare in 1975-76 to 12306 hectare in the 1980-81 and 13586 hectare in 1990-91. The area under wheat has increased due to the reclamation of cultivated land. Data indicate that wheat have remains first position in the block. Again the cultivated area of wheat in the block of Nidhauli Kalan increased during the period of 1999-2000. This year wheat covered 41.26 percent to the gross cropped area of the block or 15002 hectare (Appendix-1). It maintains its first rank in the block throughout the period under study. The increased in the cultivated area of wheat may be ascribed to adequate irrigation facilities, reclamation of cultivated land and demand as a staple food crop of the area.

The development block of Jaithra have a first rank in the wheat acreage and covered 33.87 percent to the gross cropped area of the block or 11475 hectare in 1975-76. During the period of 1980-81 the cultivated area of wheat increased in the development block of Jaithara from 11475 hectare in 1975-76 to 11926 in 1980-81 and 13553 hectare in 1985-86; 14308 hectare in 1990-91; 15786 in 1995-96 and 16316 in 1999-2000. The development block has recorded the highest five yearly growth in 1985-90 during the period under study it was 13.64 percent (Appendix-1). This tremendous increase in the area under wheat cultivation is ascribed to the diffusion of innovation and the application of highly mechanized agricultural appliance.

In the district Etah, the development block of Soron has the highest its cultivated area under wheat cultivation i.e. 17404 hectare or 35.61 percent to the gross sown area in 1999-2000. The development block of Soron have 8.93 percent acreage under wheat cultivation of the total wheat acreage of the area under study.
PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

Fig - 4.3
PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

Fig. 4.4

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PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS
1975-2000

Fig -4.5
PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

Fig -4.6
PERCENTAGE OF GROSS SOWN AREA UNDER DIFFERENT CROPS

1975-2000

Fig -4.7
In Marehra wheat occupied 30.38 percent to the gross soon area or 7921 hectare, during the period, 1975-76. Wheat became a crop of first rank during the same period during the period 1980-81, the cultivated area of wheat increased in the block of Marehra. Here the wheat occupied 31.01 percent to the gross sown area or 8231 hectare during the same period. Data indicate that the lower position in comparison to other block under study. Again the cultivation of wheat in the Marehra increased during the period of 1985-86. This year wheat covered 38.93 percent to the gross cropped area or 9172 hectare. The increase in the cultivated area of wheat may be ascribed to adequate irrigation facilities and also because it constitutes staple food crop of the area. In the development block of Marehra this crop had increased its cultivated area during the period 1990-91. It occupied 36.37 percent or 10036 hectare, shrank 30.2 percent to the gross cropped area or 8887 hectare in 1995-96, and again increases to 9185 hectare or 30.1 percent to the gross sown area. This crop remains maintain its first rank in the block, throughout the period under study (Appendix and figure-4.3 to 4.7)

The figure 4.8 and 4.9 show that wheat is the first ranking crop in all the development blocks throughout the period under study. This trend may be ascribed to assured irrigation facilities; high yielding varieties of wheat, good soils, high return and the most important factor is the high demand because of the staple food crop of the region.

A detailed study of the spatial distribution of important crops in the district Etah reveals that the wheat occupied the highest percentage of cultivated area in the last two decades, i.e. 1975-2000. It is followed by pearl millets, the second important crop of the district next to wheat. A study of statistics related to pearl millets a show that
DISTRICT ETAH
THIRD RANKING CROPS
1975 - 76

INDEX
- Pearl millets
- Green gram
- Peas
- Maize
- Barley

Fig. 4.10
in most of the blocks of the district pearl millet is cultivated in large area. In the year 1975-76, Jaithra that ideally suited to the cultivation of pearl millets devoted 27.91 percent of its gross cropped area. Kasganj with 25.98 percent of its gross cropped area followed it. The other blocks are Sahawar, Amanpur and Soron, which devoted 23.16, 22.68 and 21.3 percent of their gross cropped area respectively (Appendix-1). In the year 1980-81 all the blocks of the district represent a slight increase in pearl millets acreage. During this period in some blocks pearl millets become third ranking crop e.g. Awagarh and Sakeet. While in Kasganj pearl millet was first rank crop during the same period (1975) with 26.87 percent to its gross sown area. In the year 1985-86 all the blocks of the district shows a decrease in acreage under this crop. This decrease in the millets is due to low return. During the period of 1990-91 pearl millet acreage again slipped down in all the blocks of the district under study (Appendix-1). The highest percentage of the millets acreage was recorded from Jaithra with 18.95 percent to the gross sown area in 1995-96 and lowest percentage was reported from Sakeet since Sakeet is wheat producing area which mostly depends upon tube-well irrigation, it devoted very small acreage to this crop. In the year 1999-2000 Kasganj improved its position from 18.57 percent in 1995-96 to 20.27 percent in 1999-2000 while all other blocks reported between 11 to 16 percent of their gross cropped area in 1999-2000 (figure-4.3 to 4.7).

The third important crop of the district is maize. It is cultivated in all the blocks of the district. The highest percentage of acreage is reported from Aliganj with 17.12 percent of its gross sown area while the lowest with 0.85 percent is found in Sheetalpurr and 2.14 percent in Jaleser in the year 1975-76. During the same period 8 to 12 percent of its gross sown area was devoted to the cultivation of maize in all other block of the district. The percentage of the maize acreage in all
the blocks is same (between 8 and 12 percent) throughout the period under review with the exception of Awagarh in which 3 to 4 percent of the gross sown area devoted to the maize cultivation. The area under maize cultivation as a whole in the district shows an increase from 17.5 percent of the total cultivated (net sown) area of the district to 19.54 percent in 1999-2000. This happened because of increase in price and high yielding varieties of seeds. Maize have become third rank crop in the block of Soron, Kasganj, Sahawar, Guajdurdwara, Patiali, Sirpura, Marehra, N. Kalan, Sakeet and Jaithra during the period of 1999-2000 and second ranking crop in Sheetalper and Aliganj during the same period.

Rice is also an important crop and it has a spatial distribution in the entire district. Rice flourishes generally in the strip along the canal, where it occupied good acreage in the year 1975-76. Awagarh had the highest percentage of the acreage under this crop with 12.44 percent of its gross sown area. During 1980-81 Awagarh have first place in the acreage with 13.58 percent of the total rice acreage in area under study (Appendix-1). Nidhauli Kalan followed it with 12.41 percent of the total rice acreage in the district during the same period. However there was ample increase under this crop in the block of Soron, Sakeet, Amanpur, Aliganj, Jaleser etc. during the period of 1975-80 beside the above noted block.

The year 1985, 1990, 1995 and 2000 show appreciable increase in the area under the rice crop particularly in the development block Sakeet 10.46 percent 12.6 percent and 13.78 percent to the gross cropped area Awagarh with 14.5 (4239 hectare), 13.17 (3916 hectare), 12.99 (4365 hectare) and 15.56 (5145 hectare) percent to the gross cropped area respectively. It is observed that after a gap of two decades, rice improved its position in all the blocks particularly in Sheetalpur, Patiali and Awagarh. While in some other blocks, the
position with regards to cultivation of rice deteriorated particularly in Jaleser and Kasganj. Other crops like peas, oil seeds barley and gram occupy only small patches in almost all the blocks of the district under study. During the period under study, these crops which have been referred in the earlier lines have some pattern of the area distribution in the entire state. The decrease in the acreage under maize and millet in most of blocks of the district is perhaps due to more emphasis given to the wheat and oil seeds during the same period. Area under oil seeds also improved very much in the same year and Soron have first rank with 5.45 percent of it gross cropped area or 2668 hectare under oil seed cultivation and followed by Nidhauli Kalan 2488 hectare on 6.84 percent of its gross cropped area.

Pulses include pigeon Pea, green gram, lentils and Peas. The first three varieties of pulses are grown over some area almost in all the blocks of the district. Green gram constitutes an important crop of the blocks of Kasganj and Amanpur. The percentage of land under green gram varies between 5.02 (809 hectare) percent to the gross cropped area in 1975 and 14.13 percent (1868 hectare) in 1999-2000, in Sahawar. The areas under the Peas and gram have decreases in all the blocks during the period of under study. In Soron there is a decrease in the acreage of Peas from 2 percent of its gross cropped area or 611 hectare in 1975-76 to 1.6 percent or 502 hectare in 1980-81, 0.5 percent or 194 hectare in 1985-86, 0.7 percent or 230 hectare 1990-91, 0.57 percent or 213 hectare in 1995-96 and 0.59 percent or 346 hectare in 1999-2000 (Appendix-1). All the blocks of the district under study have represented a decreasing trend in acreage under the crops of peas and gram, throughout the period under study. This is because of the farmers are concentrated more on high yielding varieties of seeds, of wheat, maize and rice, and high returns. The major positions
of these crops acreage have shifted under the potato and wheat cultivation.

Besides these crops, which have been studied in detail, there are some other crops like tobacco, and sugar cane. Tobacco is the third ranking crop of Aliganj while in other blocks it is cultivated over small areas in some of the blocks of the district, their percentages are low and hence they have not been studied in the greater details. However, almost all the important Kharif and Rabi season are cultivated in the entire region with marked variation in acreage under these crops.

THE TOTAL VOLUME OF CHANGE:

Having thus examined all the leading occupiers’ cropland individually, of district Etah, it may logically proceed to a summation of the accumulated patterns of change among the major crops as a group. With the exception of a few special types of crop production offending a limited number blocks, such as tobacco in Aliganj. A tallying of the percentage points of increase and decrease among these crops, therefore, is taken to provide a reasonably accurate comparative measure of the total volume of change that has occurred over the period under review on the harvested crop land of the district Etah.

The procedure, which has been followed, is rather simple. For each of the 15 development blocks of the region under study abbreviated fractional expressions were prepared showing the size of the percentage point increase or decrease that occurred within the development block for any of the major crops found there. A crop identifying letter, together with any existing percentage point of increase where placed in the numerator position of the fraction and an identifying latter together with an existing decrease value was placed in the denominator. The percentage point values of the numerator and
DISTRICT ETAH
LEADING INCREASE CROP
1975 - 2000
LARGEST GAIN PER CENT OF
TOTAL HARVESTED
CROP LAND

INDEX
- Wheat
- Tobacco
- Oilseeds
- Maize

Fig. 4.14
DISTRICT ETIH
TOTAL VOLUME OF CHANGE
PERCENT OF TOTAL HARVESTED CROPLAND
INVOLVED IN CHANGE AMONG THE
MAJOR CROPS

INDEX
37 - 47
27 - 37
Below: 27

Fig. 4.16
denominator have been added up separately, the two seems then indicating a numerical fraction. On the basis of these computations an index has been made available for indicating the total percentage of the harvested crop land affected in a given development block as a result of changes in the relative strength of the major crops. Supposing that after the computation, the fraction 50/45 for a particular block is obtained it would indicate that 50 percent of the harvested land increase under other crops. The larger of the two digits has therefore been plotted on the map for that development block. An interesting fact is that in virtually every block in which the numerator and denominator did not balance, the numerator was the larger of the two figures. Clearly this indicates a general tendency throughout the district for the major crops to be further strengthening their land holding position out the expanse of minor crops.

Having thus achieved a measure of the percentage of that harvested cropland involved in change among the ten major crops for every block, the result appears in figure-4.16, a map which provides a comparative view of the areas where the cropland use pattern have been relatively dynamic and where by contrast they have been relatively stable. Blocks, where shift among the major crops effected 20 percent or more of the total harvested cropland are given one type of shading and may be designated as outstanding areas of change. On the other hand blocks, where the changes having effected less than 20 percent of the total harvested crop land are given a second type of shading and these may be described as having been relatively stable during the period under observation.

In examining figure-4.16, it will be noted that conditions of relative stability prevailed throughout much of the heart of the mapped area from north east Ganj Dundwara through Sahawar Amanpur Sheetalput to the Sakeet in the south. There is no block in
the district (With an exception Jalesar), which has gained less than 10 percent of the gross cropped area during the period under review.

Jalesar is the only block, which has got 8.1 percent of the gross sown area by the main crops under study. It comes under the stable region. Maximum percentages of total gross sown area, affected by change within these dynamic areas have reached as high as 37-37 in Soron and 34-09 percent of the gross sown areas in Ganjdundwara.

As by-products of the summation analysis of change, diagrams are prepared for each block which represent the crops made percentage gain or loss to the gross cropped area (figure-4.14 and 4.15). The examination of figure shows that wheat is the only crop, which has got largest percentage of gross sown area during the period under study while peas have lost maximum percentage of the cropped area.

Wheat, rice, oil seeds and potatoes are speeding in their area extent. This spared in these crops are due to the assured irrigation facilities, high productivity and demand of these product. The crops such as peas, pigeon peas, Sugar cane and pearl millets are decreasing in their area extent. The decrease in these crops is due to the demand of intensive labour and low return.

**CROP COMBINATION:**

Comprehensive understanding of crop combination of region provides a scientific basis for agricultural regionalization. No crop is grown in isolation from other crops in a given areal unit at a given point of time; however crops are grown in combination. Crop combination is of great significance for regionalization of the agricultural development.

The present study focuses upon the analysis of crop combination in the district Etah of U.P. with keeping in mind of
following objectives: first to find out the set of those crops which are
dominating in economy of each development block of the district Etah,
second to explore the patterns and changes in crop in crop combination.

Various geographers and social scientists to outline the crop combinations in different parts of the world have used a number of statistical techniques. Some geographers and social scientists have adopted the Weaver's method other methods opted like that of S.M. Rafiullah's method of cropping intensity.

In the present analysis the principles of Weaver technique regarding the calculation of crop combination region has been used. In his work Weaver calculated deviation from the real percentage of crops for all possible combination in the component areal units against a theoretical standard. The theoretical curve for the standard measurement was employed as given below:

Monoculture: 100 percent of the total harvested crop land in one crop.

2 crop Combination: 50 percent in each of two crops.

3 crop combination: 33⅓ percent in each of three crops and so on down the scale.

Minimum deviation has determined systematically through the standard deviation method as given below:

\[ SQ = \frac{\sum d^2}{n} \]
where ‘d’ is the difference between actual crop percentages in a given area unit and appropriate percentages in theoretical curve and ‘n’ is the number of crops in a given combination as Weaver pointed out the relative values and not obsolete values being significant, square roots were not extracted so that actual formula was used as follows:

\[ d = \frac{d^2}{n} \]

Weaver’s method results into suitable and accurate grouping of crops.

**CROP COMBINATION OF DYNAMIC CHANGE:**

Crop Combination regions based on Weaver’s method worked out for the year 1975-76 and 1999-2000 has been plotted in the figure 4.17 and 4.18. It may be concluded that there are four, five, six and seven crops combination in the district Etah. In all the crops involved in combination are most which occupied more than five percent of the total cropped area.

The combinational behavior of change will, of course, have its greatest interest and significance in those areas where the total volume of land affected by change has been most outstanding. Block level study has been chosen in the district Etah. For the analysis, entries were made in each of the block within the district showing all the crop combination of 1975-76 as well as 1999-2000 (Fig 4.17& 4.18).

Six blocks in the district were reported four crop combination, namely Aliganj, Jaithra, Jalesar, Sirpura, Soron and Kasganj in 1999-2000. In all the combination three crops are common e.g. wheat, pearl millet and maize while fourth one is varies, from one block to the other.
In 1975, two blocks, Jaithra and Aliganj were three crop combination i.e. wheat, pearl millet and maize in each block, while the Jalesar, Sirpura and Soron were five crop combination region, the crops in this region wheat, pearl millet, barley, oil seeds and rice in Jalesar, wheat, pearl millet, pea, maize and rice in Sirpura and wheat, pearl millet, maize, green gram and pea in Soron. The development block Kasganj was four crop combination region in 1975 with the crops- pearl millet, wheat, pea and maize; Kasganj was remains four crop combination region with the crops wheat, pearl millet, maize and green gram. It shows that the numbers of crops in the combination are same but the sequences have changed, i.e. wheat has replaced to the pearl millet from the first rank to the second and the green gram replaces the pea out from the combination.

Five crop combination regions include the development block of Amanpur, Patiali, Sakeet, Ganjdundwara, Awagarh and Sheetalpur in the region under study. Two blocks Patiali and Ganjdundwara have same crops in the combination with a change in the place of fourth and fifth crop, i.e. oil seeds and rice; and other first, second and third crops are wheat, pearl millet and maize. These two blocks (Patiali and Ganjdundwara) have identical location. In 1975-76, Ganjdundwara was three crop combinations and Patiali was four crop combination regions with the crops wheat, pearl millet, maize and rice. Both Sakeet and Awagarh is five crop combination regions, but the rank of crops in the combination is different from other five crop combinations, i.e. rice is the second ranking crop in this combination and cash crop, green gram is the third and fourth ranking crop. In 1975-76 Sakeet was four crop combination region with the crop wheat, maize, pearl millet and rice, while Awagarh was six crop combination with the crops wheat, rice, pearl millet, green gram, oil seeds and barley. Amanpur and Sheetalpur development blocks which
are five crop combination regions, have green gram as a second
ranking crop; it shows that in these blocks the farming system have
transformed from subsistence to commercialized agricultural system.

Three blocks namely Sahawar, Marehra and Nidhaulikalan fall
in the category of six crops combination. Sahawar and Marehra were
five crops combination region in 1975-76, the crops in the
combination were different from each other i.e. wheat, pearl millet,
maize, pea and sugarcane in Sahawar and wheat, pearl millet, green
gram, maize and pea but the addition of the six crop in these block is
also not same i.e. rice in Sahawar with fifth rank and oilseeds in
Marehra with the fifth rank too. In all the six crop combinations
region only that crops are introduced of which high yielding varieties
have become available in the market i.e. rice and the cash crops
(green gram, oilseeds etc.).

In subsequent studies of the factors involved in producing crop
land use changes, such crop-combination behavior of district obviously has a high level of utility. In their competitive relations
specific crops do indeed assume elements of comparative strength and
weakness in their on individual right, but at least equally significant,
(and perhaps even more demanding of careful scrutiny) are the elements
of strength and weakness that derive from the favorable and
unfavorable association of one crop with another. This is to recognize
the fact that often the production management relationship between
two or more crops are such as to give to each individual in a
combination, is more advantageous or disadvantageous position than
it would have if considered alone and by itself.

From the (Appendix-1) it is clear that wheat is the most
important crop among all the crops grown in the district Etah. It
enters into combination with other crops as a first ranking crop in all
the blocks of the district. The farmers under physico-social conditions
prefer to devote their arable land to several crops. The high diversification of crops is based on the assumption of perfect certainty. Relation of this assumption may have considerable bearing on the decision making of the farmers. Generally, the farmers of most of the blocks are interested in the cultivation of wheat, maize, pearl millet and oilseeds which shows that agricultural economy in the region is mainly market oriented.

Why does a combination of many crops result in higher returns?
Reference:


